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Railroad Forts That Go Where They Are Needed

A New Idea in Preparedness

WE have large cities, long coast lines and borders, also extensive areas that must be protected. It would be impracticable to fortify most of them by expensive fixed fortifications even though such fortifications were considered efficient.

The conditions of our roads, bridges and general topography of the country make it impracticable to move very heavy artillery rapidly, and we must look to the railroads both to transport heavy guns and to provide suitable bases from which to fire them rapidly and accurately.

The vastness of our areas, coasts and borders, demands that we have an extremely flexible as well as powerful land armament which can be operated by comparatively few men and used anywhere.

Railroads can mount twelve, fourteen and sixteen-inch guns for defense through a new invention patented by L. W. Luellen of New York, which makes it possible to protect with heavy mortars and guns our inland cities and five thousand miles of coast line, instead of the three hundred miles now protected by fixed fortifications.

Heavy guns are permanently mounted on especially constructed railway cars, which are to be quickly locked on solid concrete foundations for instant use, to secure accuracy and rapidity of fire control. These mobile armament cars are designed to utilize the present coast and inland railways to protect our seaboard, thus increasing the flexibility and strategic value of high-power guns such as are now mounted on fixed foundations.

Mr. Luellen would install at fixed points along existing railroads or at desirable strategic points, suitable concrete foundations, from which the highest powered guns may be fired. A specially-designed car will permanently mount high powered guns which may thus be swiftly transported to the point of attack, located on the foundations and brought into action.

These concrete foundations may be situated, at a very nominal cost, on main lines, spurs, or side-tracks, either singly or in groups, behind hills, in railway cuts and in secluded spots along the region it is desired to protect, as compared with the cost of placing fortifications at such points.

Should the enemy locate and obtain the range of one of the mobile batteries, the car can be quickly unlocked and moved to another location.

Present railroad facilities along the coasts of Massachusetts, Rhode Island, Connecticut, New York,—including Long Island—and New Jersey, are so located that ample gun foundations could be placed on spurs or side tracks so that any boat attempting to land must come within range of any desired number of guns. By properly grouping the concrete bases and placing one hundred and forty of them on the coast line mentioned, no landing party could reach the shores without coming within the deadly nine-mile range of six mortars.

These concrete bases would cost approximately three thousand to four thousand dollars each—total cost of one hundred and forty bases, including labor, about five hundred thousand dollars.

The mortar armament cars should be located at stations along the coast, where, upon an hour's notice, several of them could be moved into position for action.

It is estimated that to cover this shore line would require in the neighborhood of fifty mortars and ten rifle armament cars. This would mean that there would be one hundred and ten guns on mobile car equipment with total outlay (estimating the car and guns to cost one hundred and fifty thousand dollars) about nine million dollars.

Approximately twenty to twenty-five men would be required per car. Thus, for the cost of one modern battleship, we could equip these shores with new mobile armament containing one hundred and ten guns, which could be more accurately fired and which would be strategically more effective, with little risk of losing a single battery.

This is not the first time that railway forts have been proposed. The idea is at least twenty-five years old. The famous Creusot works of France about three years ago actually built a railway battery. How successful it was we do not know. Mr. Luellen has made a distinct contribution in suggesting concrete emplacements.

This hen stops at a hotel. Lady Eglantine, the prize egg-layer of history, is worth anything you please because she transmits her admirable proclivities to her progeny

Lady Eglantine: The One-Hundred-Thousand-Dollar Hen

A HEN whose value ranges all the way from $1,000, to a prince's ransom (whatever that may be), because money cannot buy her, recently attracted the crowds that frequented the poultry show held at the Grand Central Palace.

There was nothing about this clucking heroine to distinguish her from other white leghorns, and she is as modest in her fame as world's title holder as if she had not laid one of the three hundred and fourteen eggs that she deposited to her credit in three hundred and sixty-five days. Furthermore, she was bright and lively and exhibited none of the temperament that one reasonably looks for in any great *artiste*.

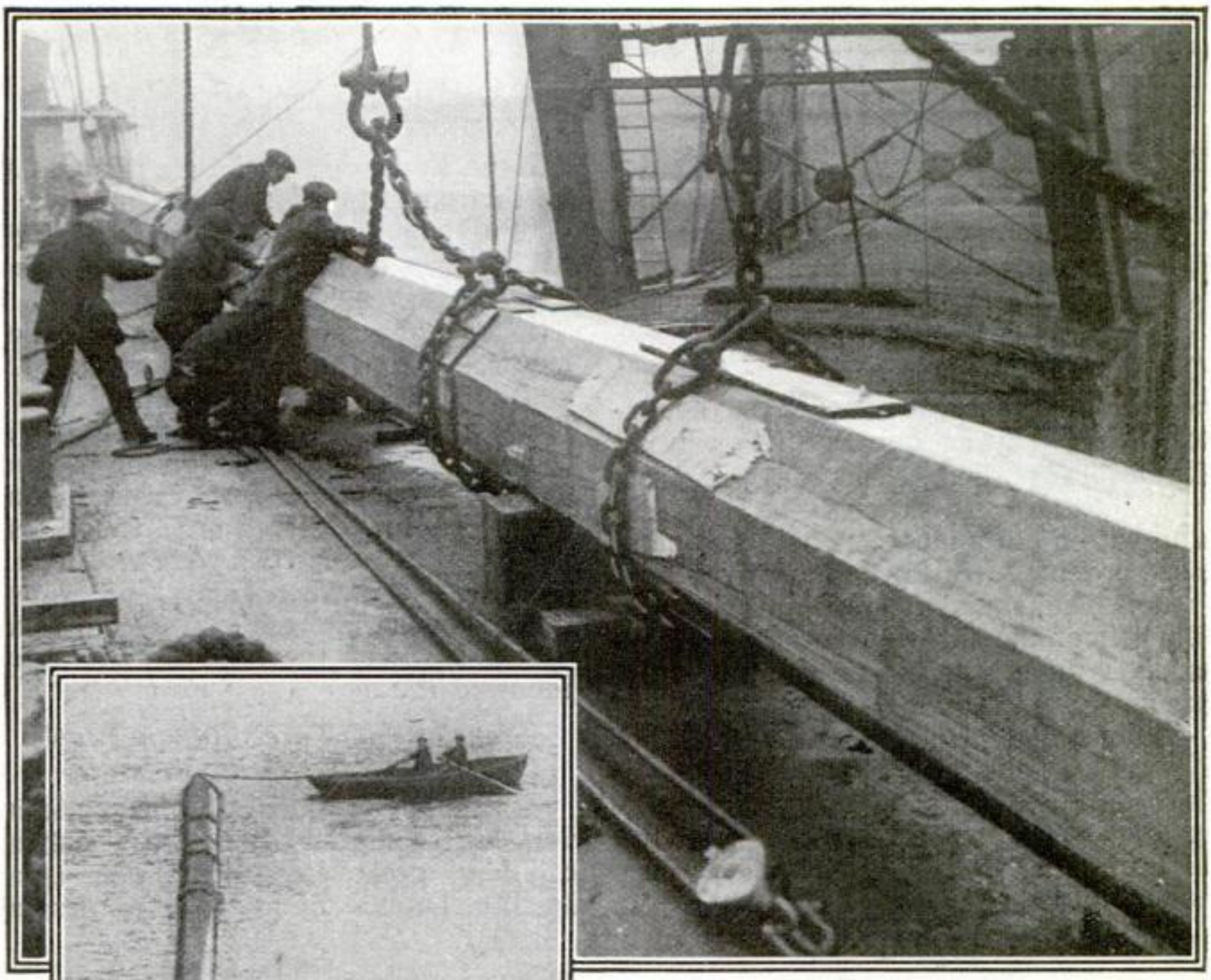
In the first place, and so that your understanding of this item of the day's news may be well based, the bird was hatched at Greensboro, Md., April 15, 1914, on the Eglantine Farms, run by A. A. Christian. She was one of five single-comb white leghorns placed in a pen at the egg-laying competition on the grounds of the Delaware Agricultural Experiment Station at Newark, Delaware, from November 1, 1914, to October 31, 1915. In this time she made her record. She is black-eyed, fourteen inches high and weighs four pounds. She has a perfect figure.

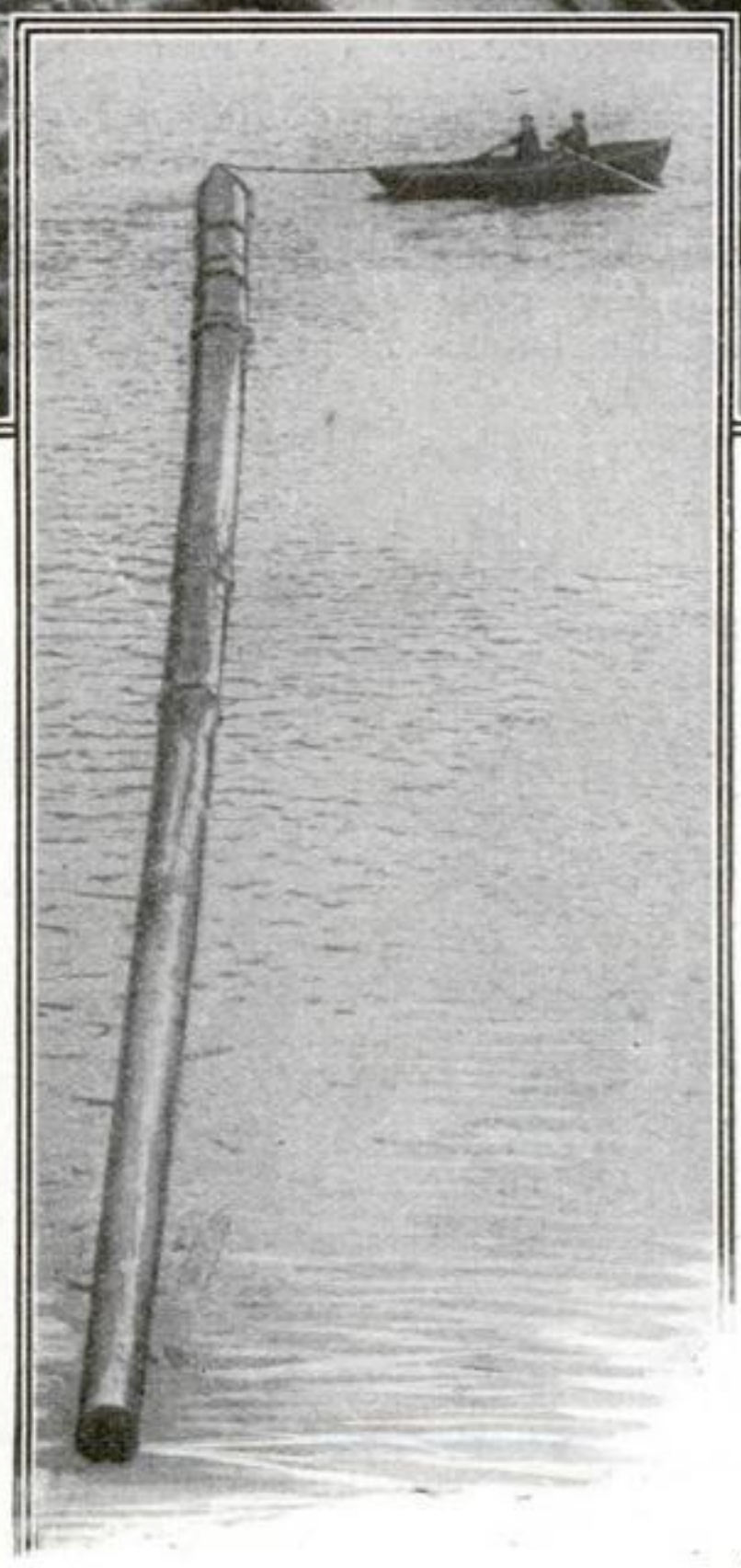
Mr. Christian was offered a great deal of money for Lady Eglantine but he will not sell her. No price, he says, will tempt him. When Mr. Christian's attitude on this became known somebody said the bird was worth $100,000, whereupon she was called the "$100,000 hen." But she might just as well be called a $1,000,000 hen, for nobody can estimate her value.

THERE was a large decline in the industry of mining precious and semi-precious stones in the United States during 1914.

The April Popular Science Monthly will be on sale Wednesday, March fifteenth (West of the Rockies, Tuesday, March twenty-first).

The World's Largest Flagstaff





Unloading the largest flagstaff in the world. This huge timber was brought to London from British Columbia, and is shown being towed up the Thames to Kew, where it will be erected in Kew Gardens

A HUGE log, two hundred and fifteen feet long, and weighing eighteen tons, was recently transported from British Columbia to London, to be erected as a flagstaff in Kew Gardens.

The transportation of this great timber across the ocean presented unusual difficulties. The pole was finally secured to the deck of a steamer, close to the rail, much to the discomfort of the ship's passengers.

Upon its arrival in London, a number of cranes, operating simultaneously, slid the timber free from stanchions and deck houses, and dropped it into the water, where a line was secured to its butt to tow it up the Thames River to Kew, where it will be erected.

The Giant Task of the Subway Diggers in New York

By Charles Phelps Cushing

IS there anywhere in New York tonight a cross section of street-life more dramatic in contrasts than the bit of Broadway in front of the Metropolitan Opera House? The Great White Way is gay, thronged, and glittering. The opera is just over; crowds in evening clothes, silk-hatted and the bejeweled, are pouring out to their waiting limousines. There, as in past years, the pageant of wealth parades—but this season with a difference. The sidewalk and the pavement of Broadway are now rough planks, and from below this rumbling floor the shrill tattoo of a drill resounds upon rock. Picture this cross section:

Above that plank floor, the silks and jewels and glittering lights; below it, in half-darkness, a squad of laborers in greasy overalls, stained with sweat and mud, risking their lives to build another subway.

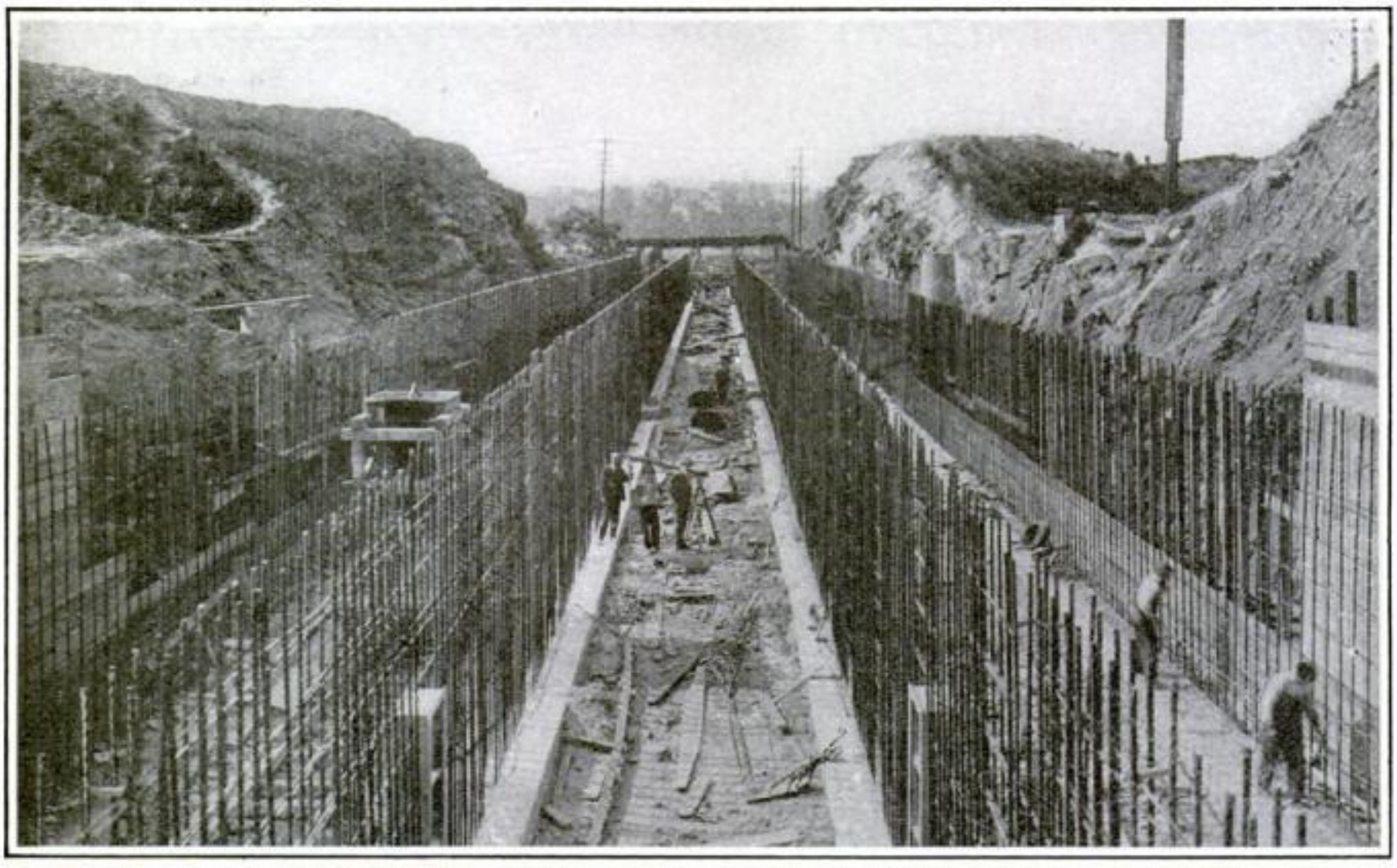
New York rarely gives a thought to its thousands of sappers and miners.

"Building another subway," it says. "Wish they'd hurry and get it over. They've torn up half the town."

So a khaki army in the subway trenches hurries, by day and by night, risking life and limb like soldiers. The peril of the job is a story in itself, not to be told in a paragraph. Suffice it, for the present, to say that only a few yards farther down the same street one person was killed and three persons were wounded a short time ago when a layer of "rotten stone" slipped into the subway ditch and half a block of the floor of Broadway followed it.

Transporting Three Billion People in a Year

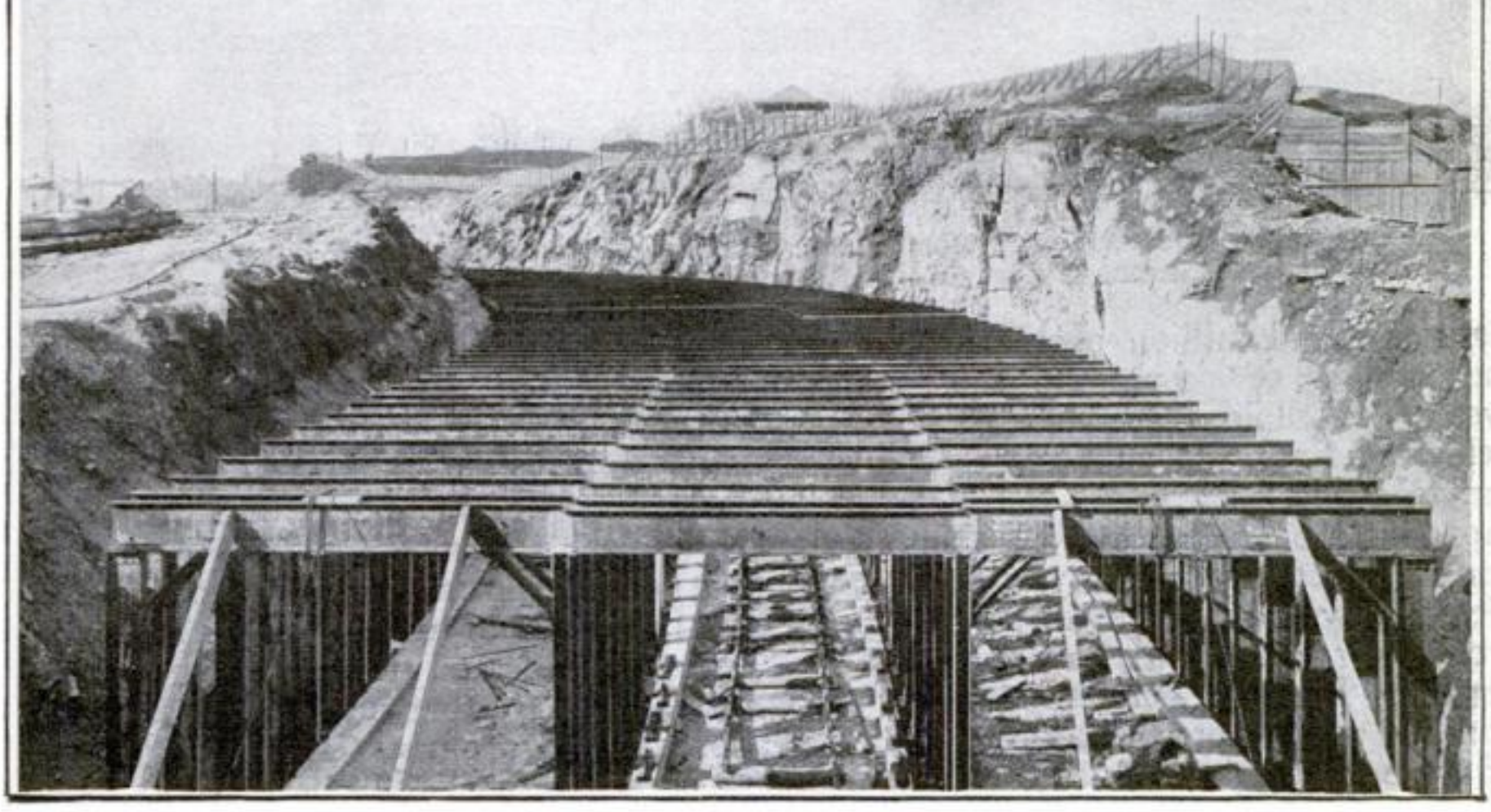
The average resident of New York has very little comprehension of the vastness of these great engineering operations. Is the human mind able to picture

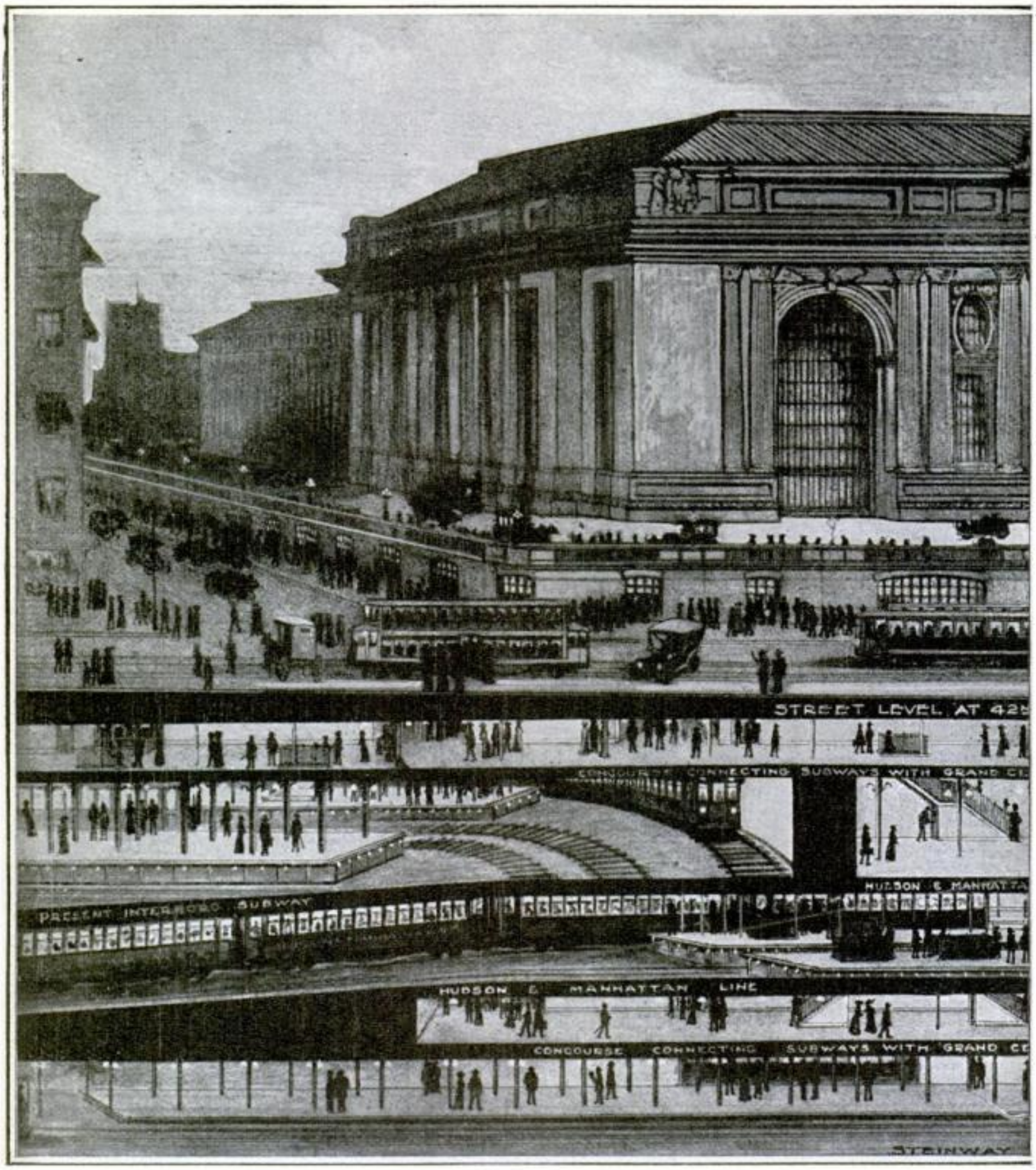


The simplest method of building a subway, known as the "cut and cover" method. If the entire length could be built with open construction, the engineers would have a comparatively simple task. The twisted vertical steel rods are the reënforcing members for the concrete walk

In the illustration below may be seen one of the many trestles which carry gaspipes across a torn-up street. After one serious explosion, New York put these pipes in the air where leaking gas would escape without danger of a catastrophe. The average cost of doing this is twenty-five hundred dollars; and where larger distribution mains must be handled, the cost runs as high as ten or eleven thousand dollars

The great tangle of pipes and conduits shown above must all be separated and placed within narrow confines, since they interfere with the progress of the tunneling. Great patience, as well as ingenuity, must be exercised in unraveling these tubes without accident. Below may be seen a section where open construction is employed. Many square miles of pavement have to be torn up to prepare for the digging operations. After constructing this part of the subway, the earth is again filled in above, new pavement has to be built, and the interior work is then completed

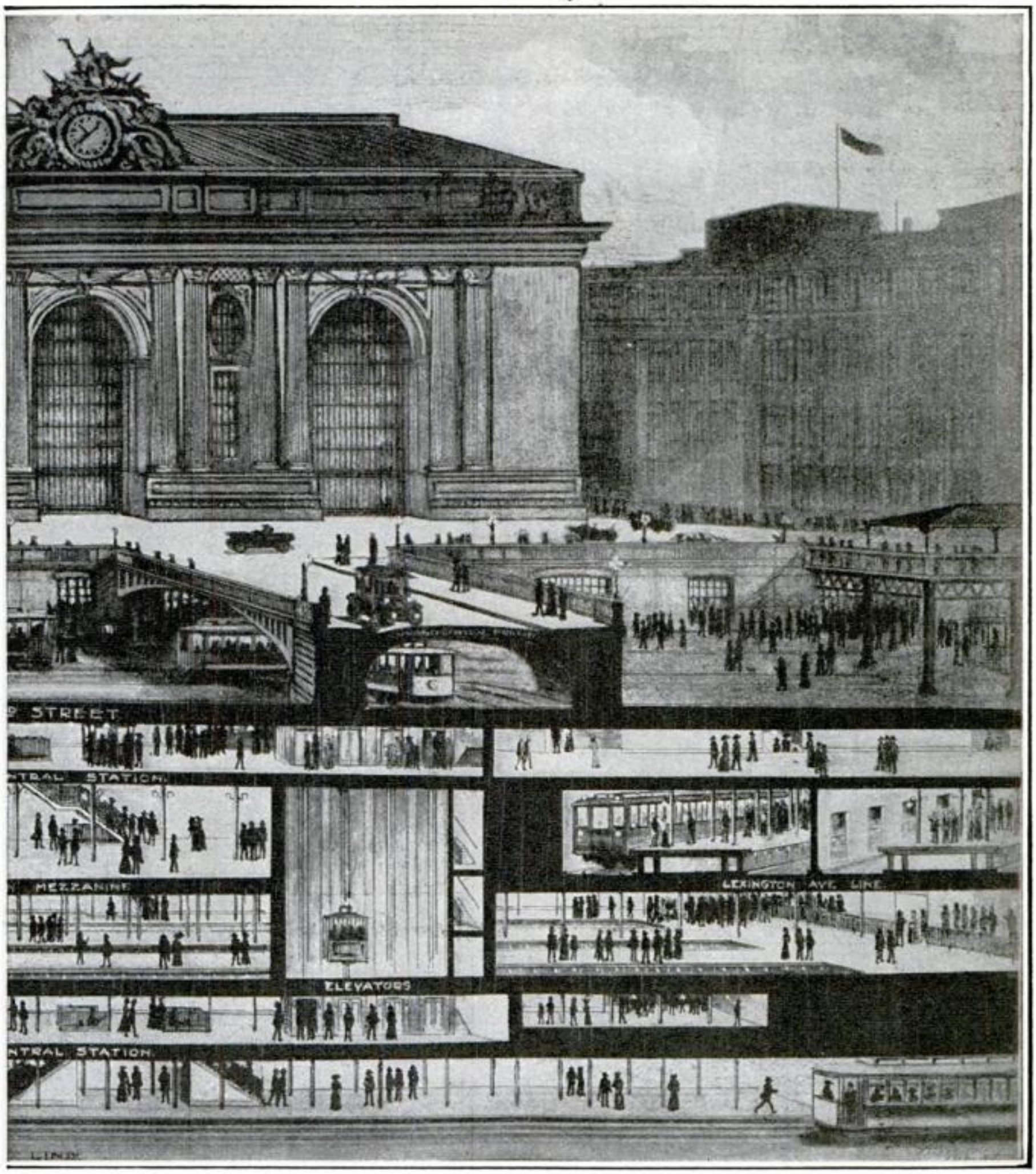




An engineering undertaking of tremendous difficulty. This honeycomb of tunnels at the Grand Central Station, at Forty-second Street and Park Avenue, New York, is being dug

eight hundred million people? That is the number of passengers the present system of rapid transit in New York (elevated lines and subways combined) can transport in a year. This carrying capacity is being increased to three billion! When the new system is completed it would stretch, in single track, from New York's city hall into the borders of Eastern Tennessee, some six hundred and twenty-one miles. The cost of the new lines and extensions amounts to three hundred and thirty million dollars, which is to say, as much as the government has thus far expended at Panama. No other urban rapid transit system in the world will compare with New York's in magnitude.

The new subways—in single track, the total amounts to more than one hundred and fifty miles of tube and trench—are the most interesting side of the construction now in progress; for this work is at once the most difficult and the most



through treacherous and rotten rock, and has to be built without disturbing the traffic in the present interborough subway, which is to be seen on the second level in the illustration

perilous. New underground routes are being driven through some of the world's most crowded streets, and without materially interfering with the traffic. Though the typical construction is a covered ditch with a roof which is only a foot or two below the floor of the street, there are many places where real tunneling and mining operations are required. The digging goes on under a variety of conditions: through underground swamps and watercourses, through treacherous rock, through sand and even through quicksand. At the south end of Manhattan Island two new sets of tubes are being driven under East River; at the north end a set of tubes was built on shore and then towed out into place and sunk on the bed of the river. In Lexington Avenue a new idea in subway building is presented in the form of an underground double-decker. At Grand Central Station the earth is being honeycombed into five levels.

The new local tracks beneath Lexington Avenue near 74th Street. It will be noticed how free the street is from serious obstruction. This system, extended in a single track, would reach from New York's city hall into the borders of Eastern Tennessee, some six hundred and twenty-one miles

These are some of the more striking features of the work; but even the matter-of-course features loom big when one comes to inspect them closely. To make room for the subways, the space just below the street level has to be vacated of all its various pipes. The expense of moving them is enormous. Take, for example, one item, the cost of relocating sewers. Sixty miles or more of new pipes are being laid. The bill for these changes comes to more than six million dollars. One of the largest of the diverted sewers is in the neighborhood of the Pennsylvania Station, at Seventh Avenue and Thirtieth Street. Now that a new subway is coming up Seventh Avenue, this sewer is being rebuilt to give outlet into North River—at a cost of five hundred thousand dollars.

Or consider the fact that while construction is in progress under the street, many gas-mains must be carried over the roadways on trestles. The average cost of doing this is twenty-five hundred dollars; and where larger distribution mains must be handled, the cost runs as high as ten or eleven thousand dollars.

Street-Cars and Wagons Carried on Dry-Land Bridges

Or, again, in accounting for where so many millions must be spent in building subways, consider that the engineers never vacate more than half of the roadway at a time, and that the street-railways overhead and all the stream of vehicles and pedestrians are literally carried, while the digging is in process, upon miles and miles of dry-land bridges. They are the longest bridges in the world, and bear as much traffic as the busiest in the world.

Then, too, hundreds of buildings must be shored up, for many of them are not built upon the solid rock; and rotten strata of treacherous stone must be braced to prevent slides. In a number of instances buildings had to be torn down. The famous old Astor House was one of these. It stood on sand at a corner under which a tube had to pass.

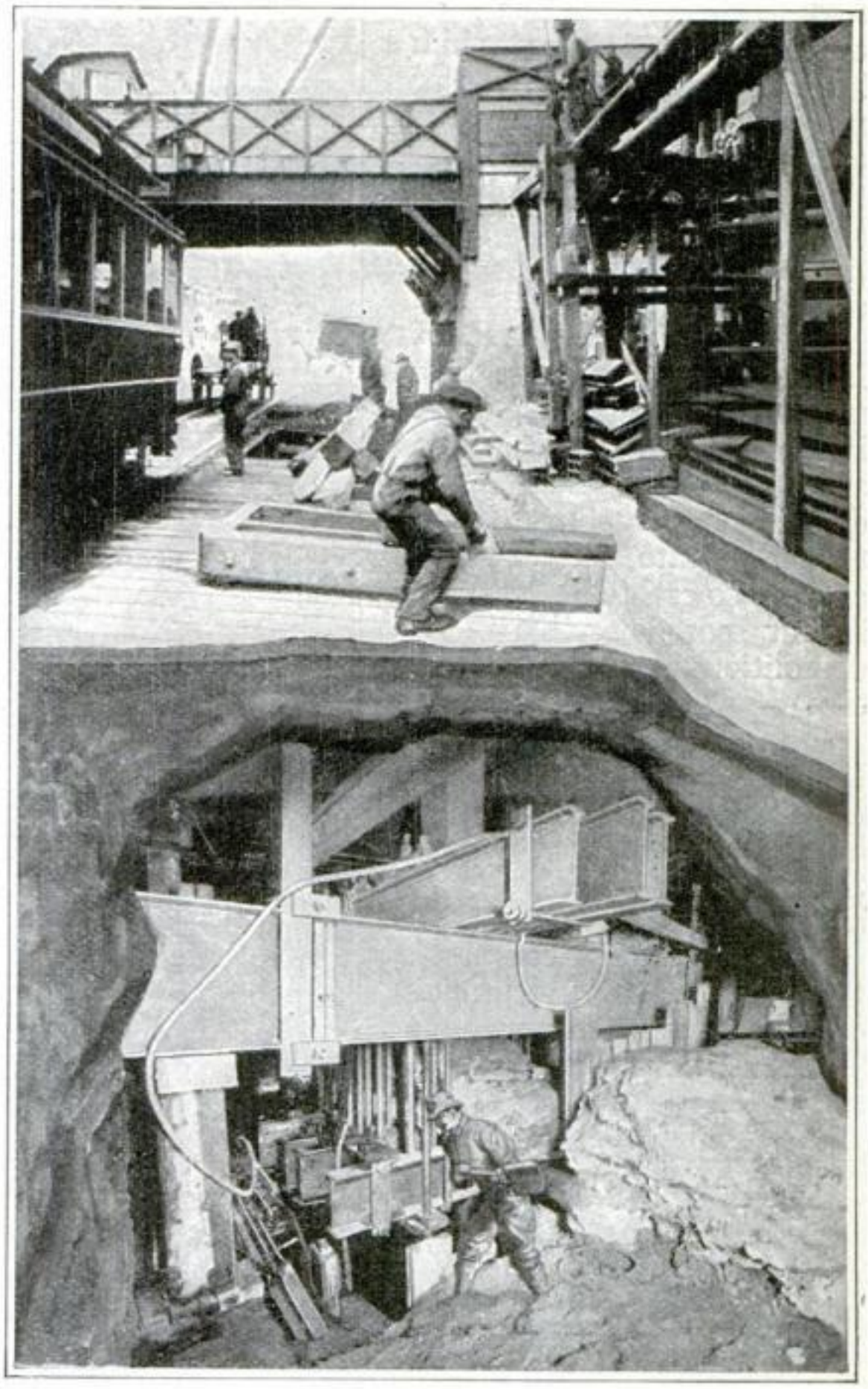
But one of the most ticklish operations of all is a section of new subway in William Street, where the underlying mate-

rial is quicksand. William Street is a narrow winding lane of old downtown New York. It is barely forty feet in width between building fronts, and in the half-mile section where the subway is being dug (from Beekman Street to Pearl) it bears twenty buildings of from seven to twelve stories in height, and ten of from thirteen to twenty stories. When the digging was first proposed, owners of abutting property assessed at forty million dollars protested and carried the case into court. The Public Service Commissioners had so much confidence that the work could be done safely that they assumed responsibility for any damages that might result.

Building on Water

"The conditions encountered are unique," writes John H. Madden, Asst. Division Engineer, "in the number of large and heavy buildings, few of which have foundations to rock or hardpan, and with these exceptions all other foundations are above the subway subgrade and uniformly above water level as well." The subway's floor is, in general, three to five feet below mean low water; and below ground water level the material is swimming sand. "To guard against any possible flow of material into the subway trench, continuous bulkheads, either in the form of rigidly held, tight sheeting or concrete cut-off walls, will be introduced between the underpinning piers so as to form an integral portion of the latter and will be carried to such depth below the subgrade of the subway as to eliminate any tendency of the quicksand to flow under the toe and be released into the excavation." The total estimated cost of the section is two million, two hundred fifty-four thousand, six hundred and seventy dollars, of which six hundred and four thousand, five hundred dollars is for underpinning.

William Street is not the only place where the subway diggers have to be particular about building stanch floors and sidewalls. At Broadway and Canal Street an underground watercourse was encountered and a very heavy floor had to be built to resist the water's upward pressure. Pumps with a capacity of twenty million gallons a day were kept



One of the serious difficulties often met by the engineers. Underground water is seeping into the tunnel near the corner of Broadway and Canal Street so fast that a set of pumps removes twenty million gallons a day from this one spot. The flooring here is reënforced to resist the upward pressure of the water and quicksand

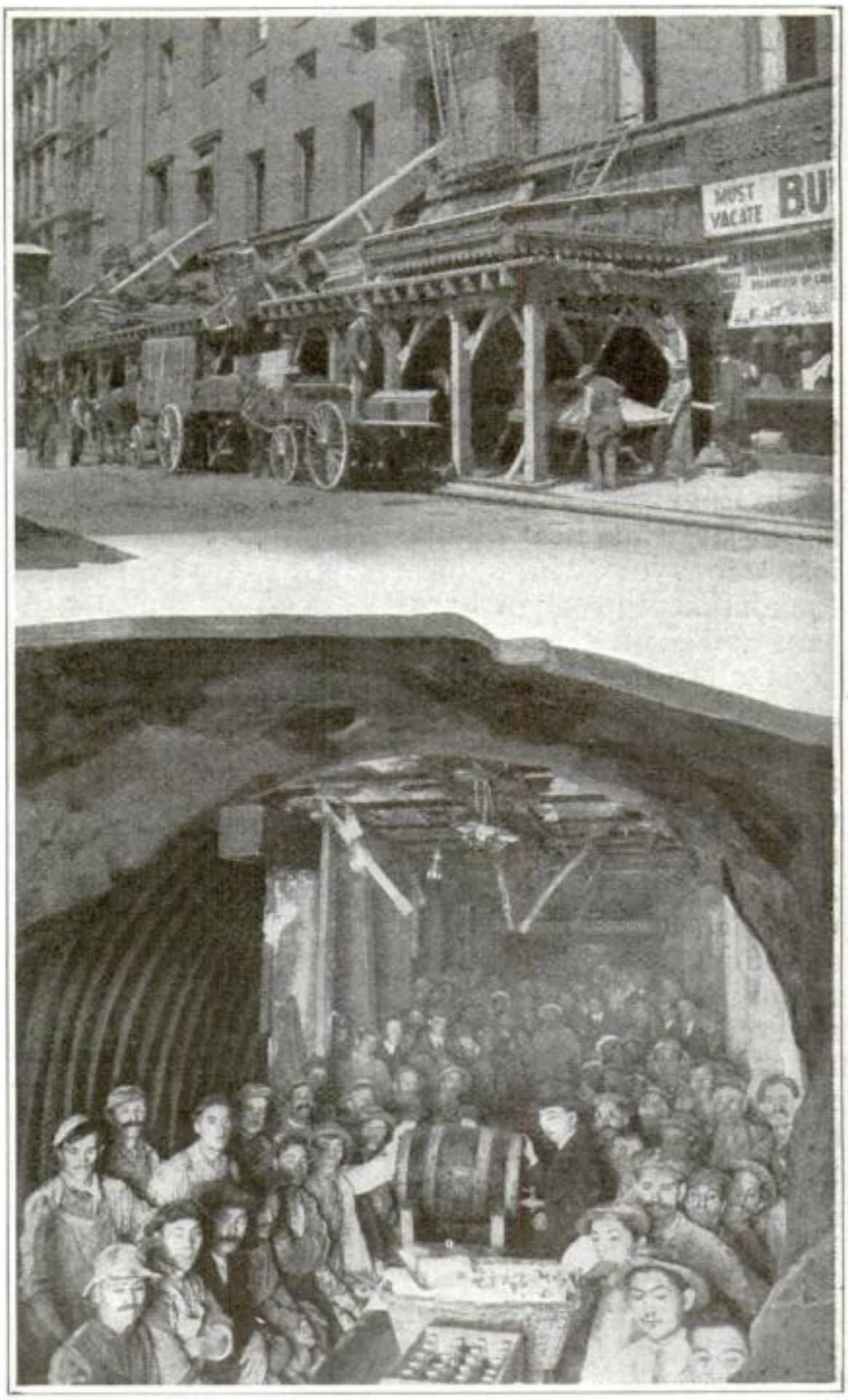
busy for a while, discharging a volume of water as great as the daily supply required for a city the size of Atlanta. Care had to be taken, meanwhile, not to pump out sand along with the water, or the adjacent buildings would have come tumbling down, just as in a certain engineer's vision of the most effective way of destroying the city of Boston:

"An enemy need not bother mustering battleships or waste his time bombarding from afar the intellectual Hub of this land of ours. In time of peace let him have his spies build a big pumping station right in the middle of that city, and at the proper time start drawing indiscriminately from the ground below the water saturating the subsoil. You know a large number of Boston's big buildings rest upon floating foundations. Pump out the water in the supporting quicksand, and down those structures would tumble into the yawning cavities so created. It would be far more effective in its demolition than the projectiles of a hostile fleet!"

Up near the north end of Manhattan Island, at Lexington Avenue and One hundred and Twenty-ninth Street, the subway diggers had to construct another stout waterproof floor when they encountered what evidently was once a swamp.

We mentioned, in passing, the razing of the old Astor House, which was built upon sand. The tunnel which comes up Vesey Street and cuts under the site of the old hotel curves around into Broadway through big cylinders of cast iron.

Underground swamps and watercourses, sand, quicksand, sand mixed with boulders (as in Brooklyn)—all these the diggers encounter and vanquish. But what the subway builders fear most is something different from all of these: a material known to the geologist as Manhattan Schist and to the rest of us as "rotten rock." No material is more treacherous than this, for along with layers of extreme hardness are pockets and seams of disintegrated stuff, some of it so soft that, after it has been exposed a little

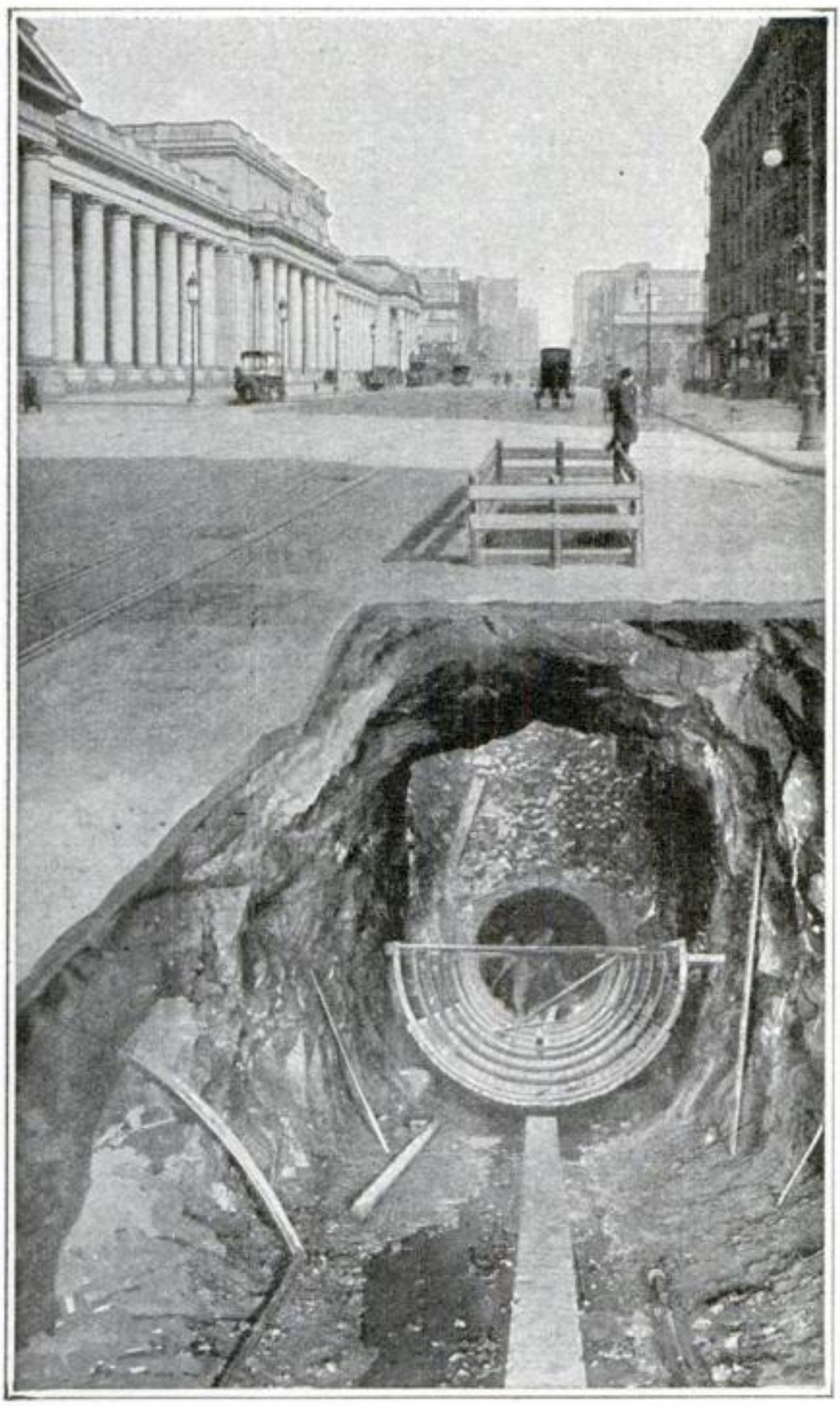


Under the old Astor House, which has been torn down because an underground swamp made it extremely hazardous to tunnel beneath the building. The illustration shows an underground dinner of celebration when a section of the iron tubes for one of the subway lines was completed. The arch of the big tubes shows in back of the posts at the left of the picture

while to the air, it can be crumpled in the hand like earth.

When New York built its first subway, the engineers encountered some of this "rotten rock" in Park Avenue near the Grand Central Station. Serious slides resulted; houses caved in. And the builders of the new subways have not come off any more fortunately than their predecessors. Of several cave-ins the most serious recently was one in Seventh Avenue, near Twenty-fourth Street, where seven persons were killed and eighty-five were injured.

Try to conceive, then, how cautiously the engineers must work in building the Lexington Avenue double-decker subway and in tunneling the treacherous rock in the vicinity of Grand Central Station where (as an accompanying illustration tells better than whole pages of description could do) the ground is being honeycombed into five levels—this in the same perilous ground where the engineers first learned how gingerly they must proceed in a locality where the "rotten rock" literally abounds. And today an extra factor of difficulty must be confronted here from the fact that the operation of the present subway cannot be interfered with while the new tubes are being constructed.



Rebuilding and moving sewers to vacate space required for the new subways. The sewers alone mean an expenditure of from six to seven million dollars. The illustration shows a large tube making a new outlet for the sewer system emptying into the Hudson River. This outlet will cost the city half a million dollars. To the left of the picture is the magnificent new Pennsylvania Terminal

Following a blast, a slide of "rotten rock" knocked out the shoring of the wooden bridge which forms the temporary street, and engulfed a loaded street car, a large motor truck, and scores of pedestrians. Spectators said that the structure fell like a house of cards. The maze of gas pipes and electrical conduits added a grave danger, for a spark from the tangled wires would have exploded the leaking gas, and would have added many more names to the list of killed and injured.

On Saturday, of the same week, a section of Broadway fell in, endangering many lives. Fortunately, there were few pedestrians in that section of the street and only one vehicle, a taxicab, so that the casualties were few. But New York's confidence was sadly shaken.

Much of the danger of driving on snow is eliminated by the use of these skiis on the front wheels. They travel lightly over the snow, and by responding promptly to the wheel make skidding less likely

Motoring on Skiis

MOTORISTS who know the difficulties and dangers of piloting their cars through heavy snow, will greet with approval a new device which is claimed to make snow-driving safe, practical and comfortable.

Two kiln-dried white ash skiis are fastened securely to the front wheels, and carry them over the surface of the snow. In deep snow the full width of the skiis carries the load, while on a hard path only the steel guide runner touches the road. The guide runner also makes steering easy and prevents the skidding of the front wheels.

Does Your Child Suck It's Thumb?

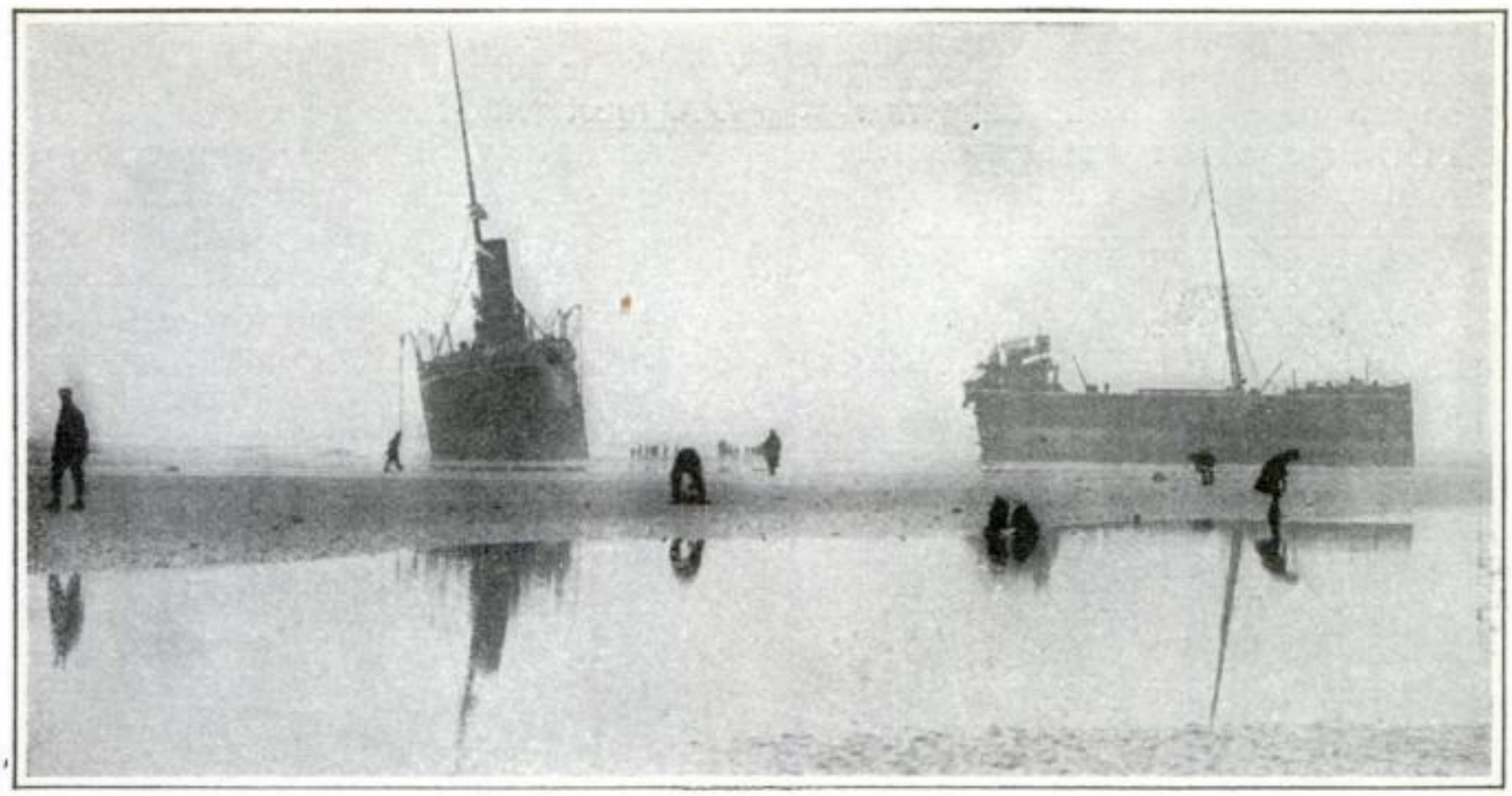
IT is very seldom that we see a straight, well-formed mouth. Sometimes it is spoiled by protruding teeth, sometimes by a large overhanging upper jaw, generally we find the upper lip much larger than the lower. This is not, as might at first be supposed, a characteristic of the American people just as flat noses are a characteristic of the Negro race. It is due to one of the most unfortunate habits that can be formed in childhood — the sucking of the thumb.

The bones of a baby's jaw are extremely plastic, and subject to almost any amount of deformity by long-continued impact and strain. If even as soft an object as a thumb is placed in the mouth for any length of time, the inevitable result will be that the upper jaw and the teeth will be pushed out of place.

Many mothers are aware of the danger in making such a habit, and they resort to what they think is the next best thing — which is in reality the next worst thing — the pacifier. Imagine a bit of hard rubber and ivory in a child's mouth during all of its waking hours, and many times its sleeping ones. It is nothing more or less than an instrument which rapidly and skilfully dislocates the teeth and the jaws. A child should not be permitted to carry any object in its mouth aside from the rubber nipple of its bottle, and even here care should be taken to see that this is removed promptly after the feeding is over.

It is not easy to prevent the baby from putting its fingers into its mouth, as this is more or less of a natural inclination. In rare extreme cases it is necessary to tie the hands. Many parents put a bitter solution on the fingers which is sufficiently distasteful to break up the practice, but this is a doubtful procedure and one to resort to only by the advice of a physician.

PENNSYLVANIA leads all other states in the country in the use of steam power, using twenty per cent. of all that is used in the entire United States.



The wreck of the steamer "Socotra," on the Brittany Coast of France, lay in two sections, wide apart, and its cargo, dumped into the sea, was protected from pillage by armed guards

Steamer Breaks Back in Storm

DURING one of the heaviest storms of the season the Peninsular and Oriental steamer *Socotra* was blown ashore opposite Paris Plage, in Brittany, France, on a night during the latter part of November. In spite of the desperate attempts of tugs to tow her away from the dangerous shoals, she broke in half a few days later.

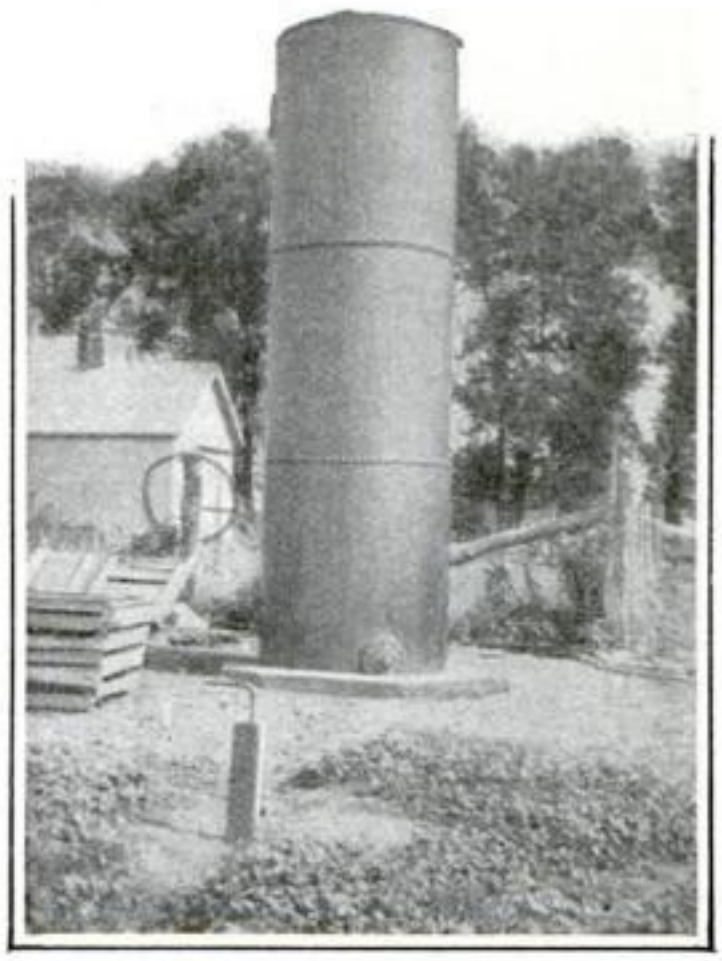
As soon as the ship was broken the packet freight with which she was loaded tumbled out of her cargo hold and was washed ashore by the waves. The local inhabitants immediately proceeded to pillage the valuable wreckage, but guards were soon called to the scene, and they remained on duty until the entire contents of the ship were safely removed.

It can be seen from the photograph that the *Socotra* was broken a few feet forward of the engine, the two halves being forced several hundred yards apart before the storm abated.

An Old Boiler Used for Stand-Pipe

OLD boilers, like the one shown here, can be found in most every junk yard and can be obtained at a very reasonable price. One Iowa farmer bought an old boiler of a near-by City Council, transported it to his farm and set it up on a concrete base. He uses it for a water supply tank which gives him water under pressure in all departments of the farm.

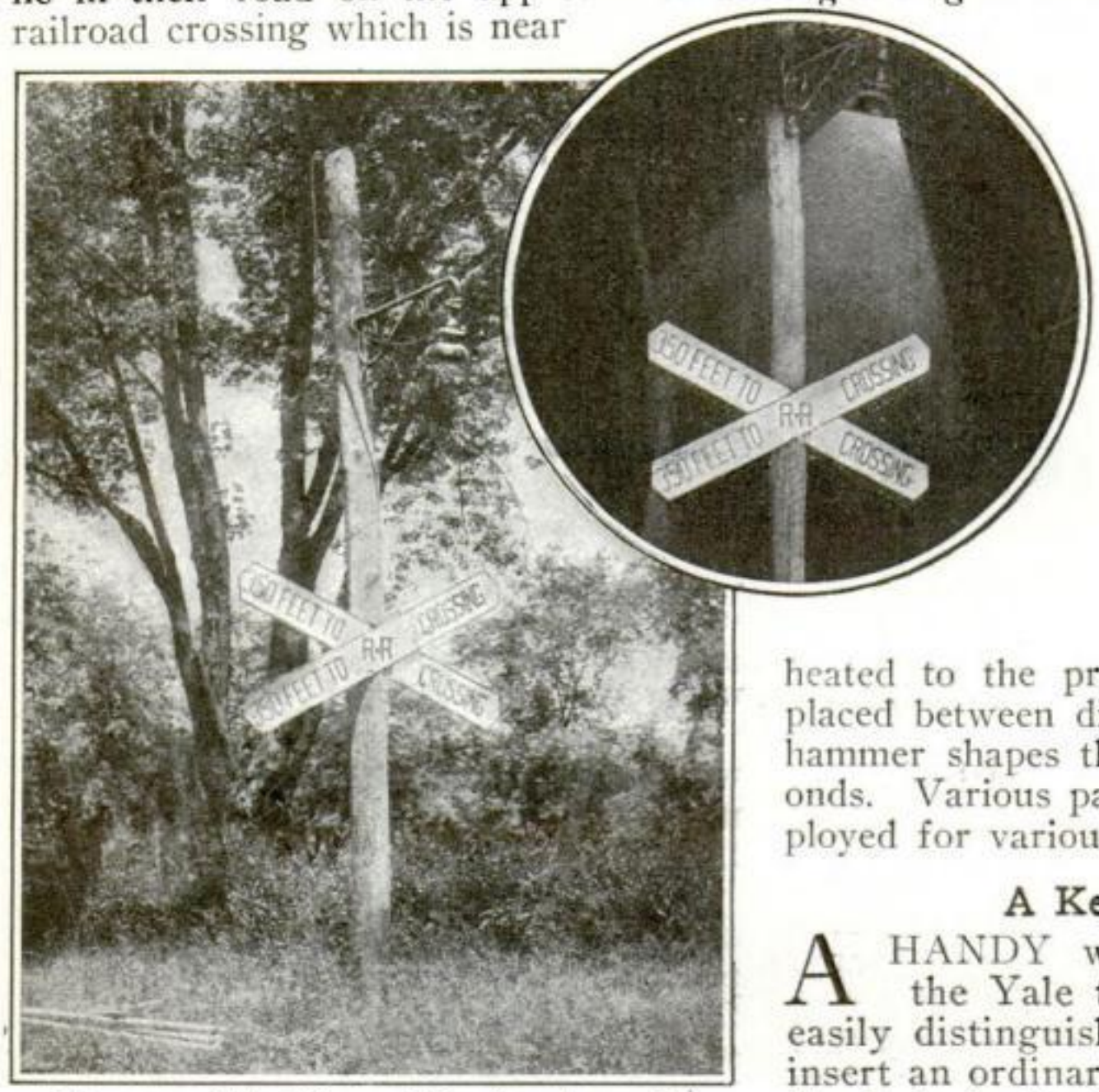
He took all the old tubes out of the old boiler and sold them for junk which paid him for hauling the outfit to his farm. The old boiler was given a coat of asphalt paint inside and out. During the cold winter months this Iowa farmer prevents the water from freezing by packing straw around it.



A farm stand-pipe made from an old boiler

Railroad Warning for Motorists

IN order that motorists who happen to be unfamiliar with the dangers that lie in their road on the approach to a railroad crossing which is near Lutherville, Md., a railroad company whose tracks run to that city has installed warning posts which can be plainly seen day or night. After dark, a powerful electric lamp behind a reflector illuminates the warning posts which can tells them that a dangerous railroad crossing exists three hundred and fifty feet ahead of them. The cross arms can be seen and read easily in the daytime, as they are placed in a conspicuous position. A bright red glass in back of the lamp, the conventional danger signal, makes the warning sign doubly effective. The scheme was devised by Walter R. Moulton, an illuminating engineer.



Day or night this roadside signal guards the wary autoist against the dangers of a grade crossing

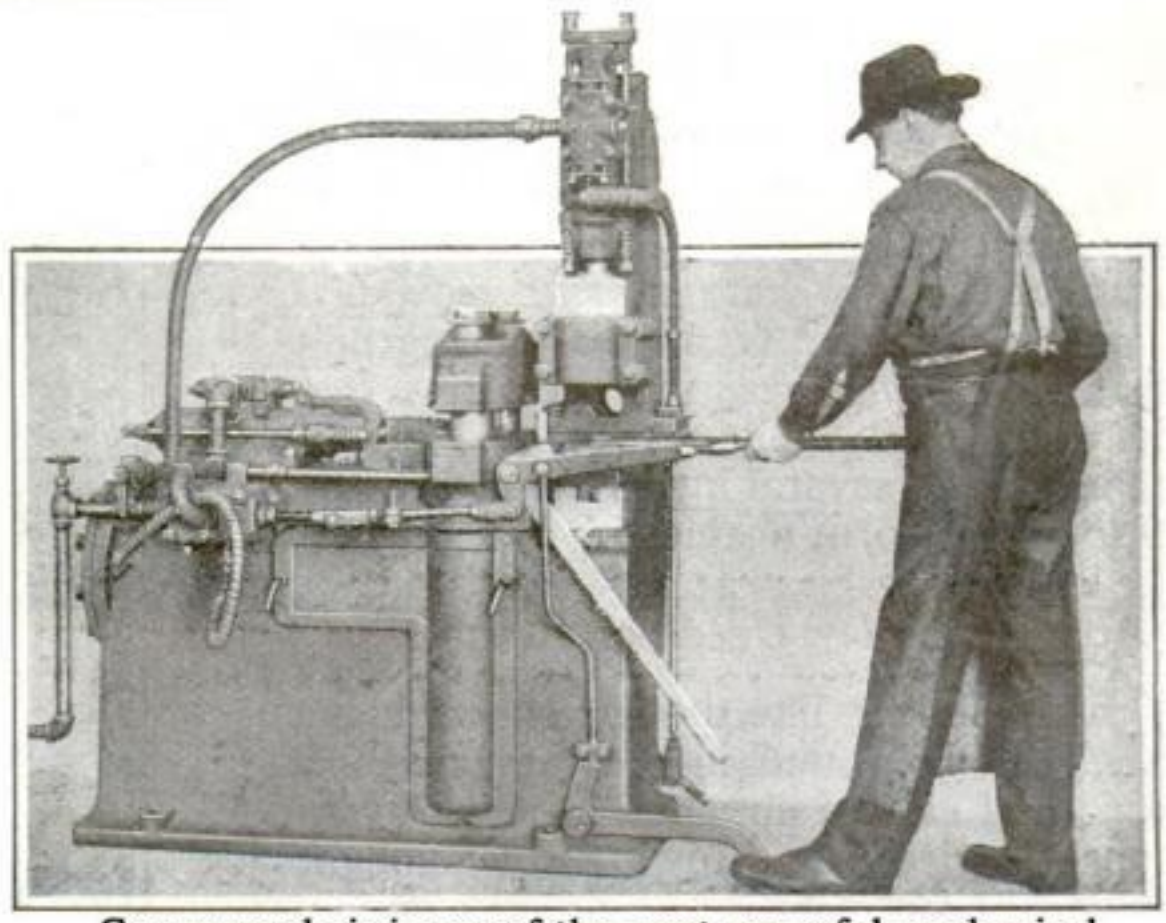
Sharpening Drills by Air

AT quarries and mines, one of the most time-consuming tasks is the regrinding of dull drills. Expert forges are required if the work is done properly. To obviate the large amount of time spent in this way, a pneumatic drill sharpener has been installed in some mines and quarries. It shortens the task of drilling to a fraction of the time formerly required when the job was done by hand.

The drill heads are heated to the proper temperature and placed between dies, and the pneumatic hammer shapes the head in a few seconds. Various patterns of dies are employed for various drill heads.

A Key Marker.

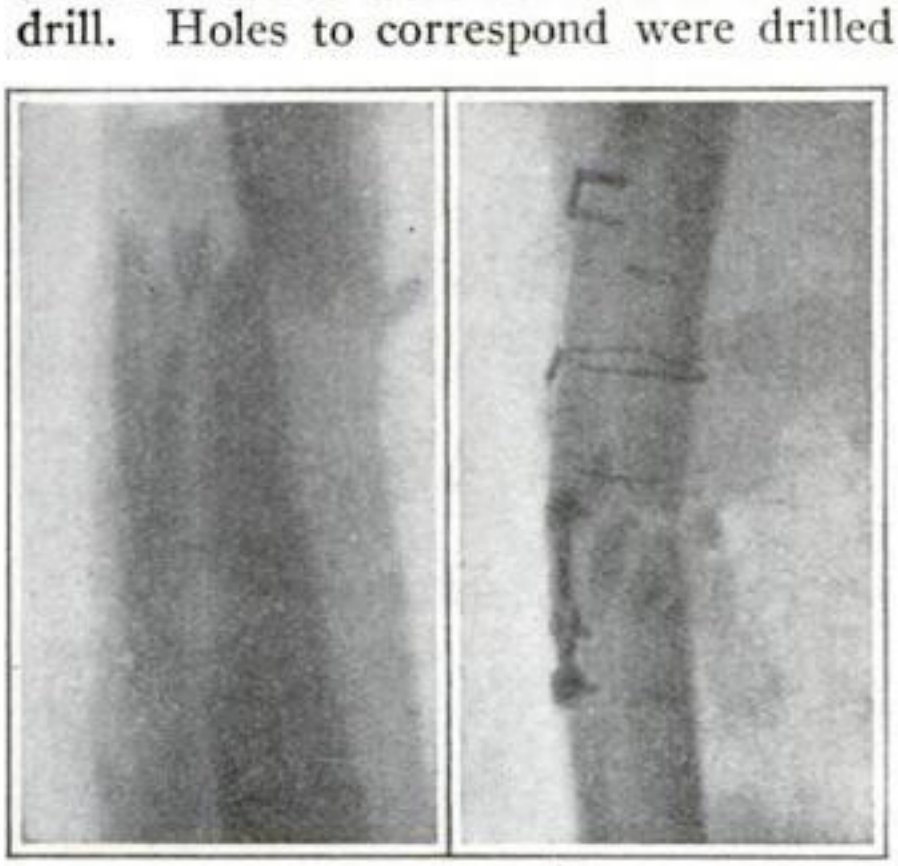
A HANDY way to mark keys of the Yale type so that they are easily distinguished in the dark is to insert an ordinary office paper rivet in the hole in the handle of one of the keys and flange it in the usual way with the punch. There is no mistaking the "feel" of a key so marked.



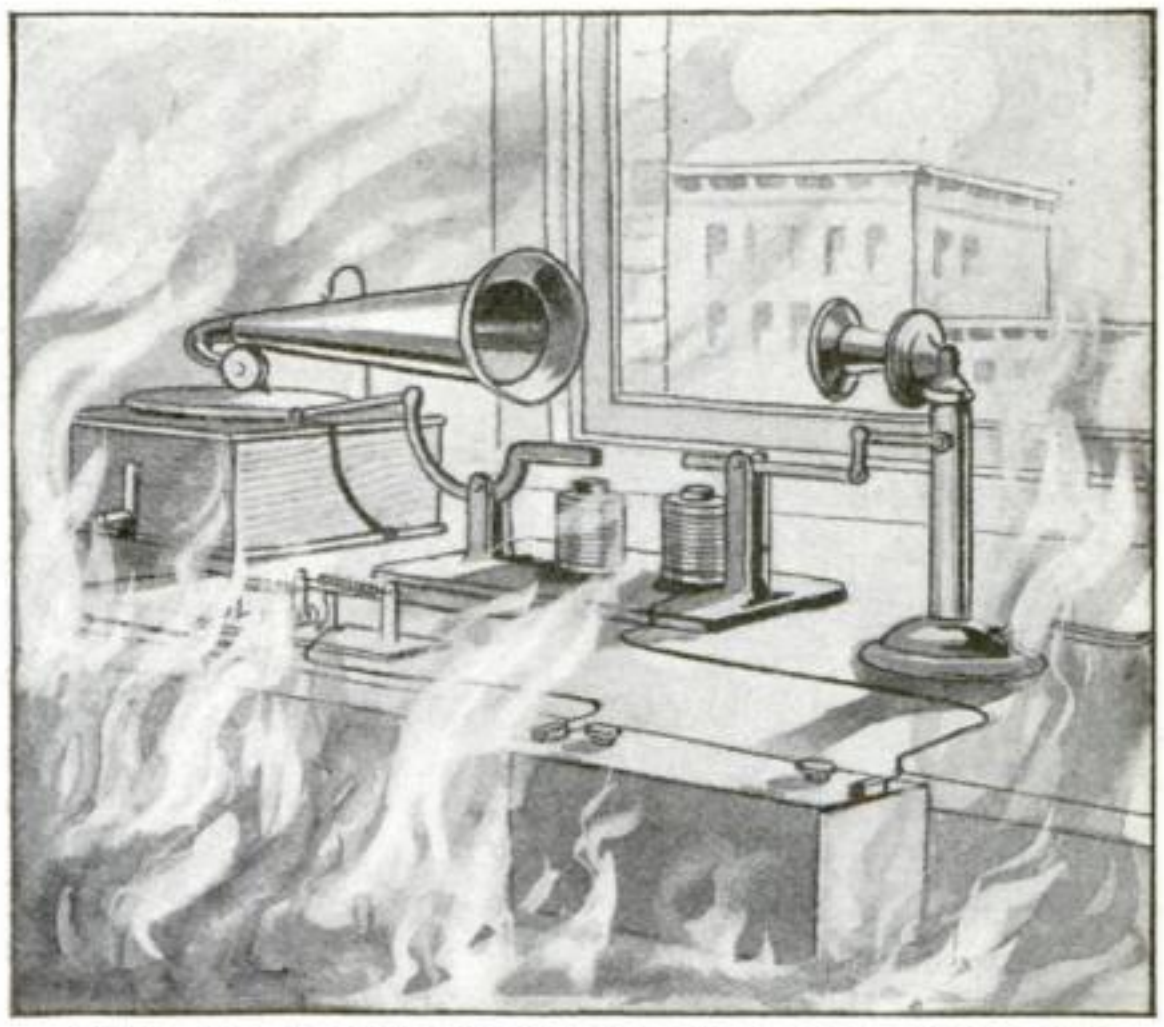
Compressed air is one of the most powerful mechanical agencies of to-day. Here it is harnessed to the job of sharpening rock drills

Mending Bones with Rivets and Wires

THE accompanying X-Ray photographs show the result of a nineteen hundred pound flywheel falling across the legs of a machinist who was handling it. The first radiograph, taken shortly after the accident, shows how the thigh bone was crushed and splintered by the heavy weight. Such is technically known as a "comminuted fracture." It was at first thought that on account of the splintering of the bone it might be necessary to amputate the leg, but a surgeon was found who undertook the splicing and reinforcing of the bone as shown in the second radiograph. This was made through a heavy plaster cast eight weeks after the bone was set. Three hours were required for the setting operation, the thigh bone being laid bare by an incision ten and one-half inches long. A vanadium steel plate secured to the bone by means of the screws bridged the main fracture, which may be clearly distinguished. The dark lines are silver wires which hold splintered pieces to the main bone. These fragments were removed, and holes to receive the wires were bored with a hand drill. Holes to correspond were drilled in the main bone and the pieces were then wired in place as shown. A wire passes entirely around the main bone (which was splintered down the center), and this serves to hold the two halves together. This wire is bronze. A vanadium steel staple holds the large middle piece to the bone below it.



Rivets, steel plates and silver wires helped to save this shattered leg



"Fire, fire, fire," loudly shrieks this phonograph into the telephone when the flames burn its restraining string

Something Is Wrong with this Unemotional Phonograph Fire Alarm

A FIRE alarm apparatus that calls "central," telling her in a calm, dispassionate, mechanical voice that the factory of Smith, Jones & Co., at No. 1 Jones Street, is in flames, and to please call the fire department immediately, is the proposal of an inventor in South Carolina. A phonograph, with its horn close to the mouthpiece of a telephone, is fitted with a record bearing the fire warning. The phonograph starts when an electro-magnet placed near it draws down the releasing lever.

The circuit of which the magnets are part, is closed by an automatic switch which is held open by a cord. A fire burns the cord, allows the switch to close, and "central" is promptly notified. But suppose a fire breaks out in the night and the operator fails to answer before the record is finished. What then?

A Giant Grinder Which Goes to Its Work

IF you have an axe to grind, it is no longer necessary to bring the axe to the grinding wheel, for a portable grinding wheel of full-sized proportions has been brought into the grinding field.

The newest thing in portable tools is a grinder which goes to the blade to be sharpened

Numerous small grinding equipments intended for light work have been introduced from time to time, but only recently has a man-sized portable grinder been a reality. A huge motor mounted on a three-wheeled truck supplies the driving energy to the abrasive wheel through flexible tubing. In operation when the speed has been adjusted to suit the needs of the workman, he grasps the handles of the wheel on either side and brings it against the object to be ground at any angle or any pressure desired. Grinders of this type are intended for use in foundries or in factories where there is a great deal of heavy abrasive work to be done.

For the mechanic who values convenience and neatness of work, this new appliance is well-nigh perfect.

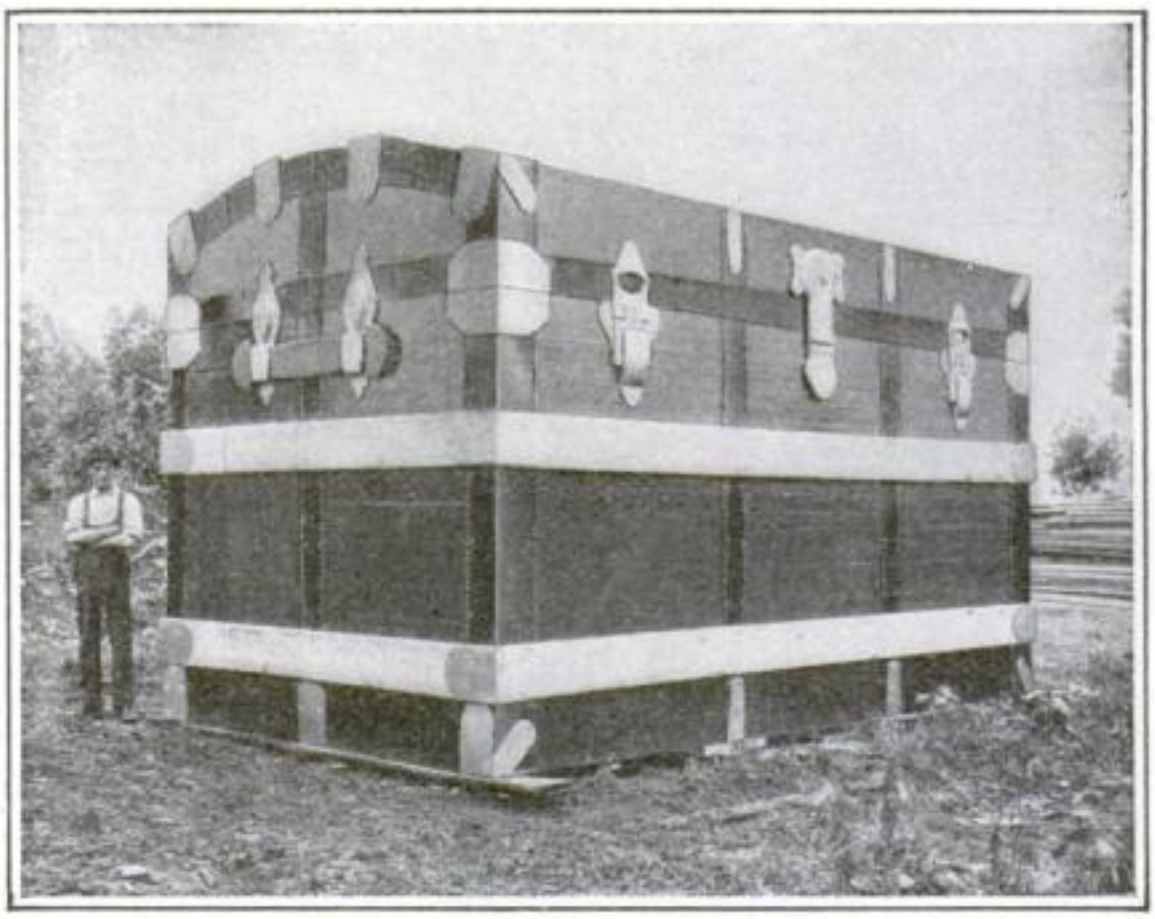
A Test for Baggage-Smashers

EXPRESSMEN who are accustomed to slamming trunks around like pasteboard boxes may not have to be cautioned to handle with care the baby elephant of a trunk pictured, for they will do well if they budge one corner of it. It was built in Fargo, N. D., and is eighteen feet long, ten and a half feet high, and ten feet wide.

To build this monster nearly two thousand feet of lumber were used as well as five hundred bolts, eighty-seven yards of canvas, ninety yards of lining, fifty-four pounds of nails, half a ton of iron, and ten gallons of paint and pastes.

The trunk is made in sections, and can be knocked down and stored under cover when not on exhibition. It is canvas-covered. The slats are made of planks; the corners and binding are of heavy iron and are bolted on. The lock is made of bronzed wood, so that it looks like brass. The handles are of wood and are covered with imitation leather. The trunk is wired for electric lights.

On the inside are a ten-foot showcase and two dray loads of trunks, bags, etc.

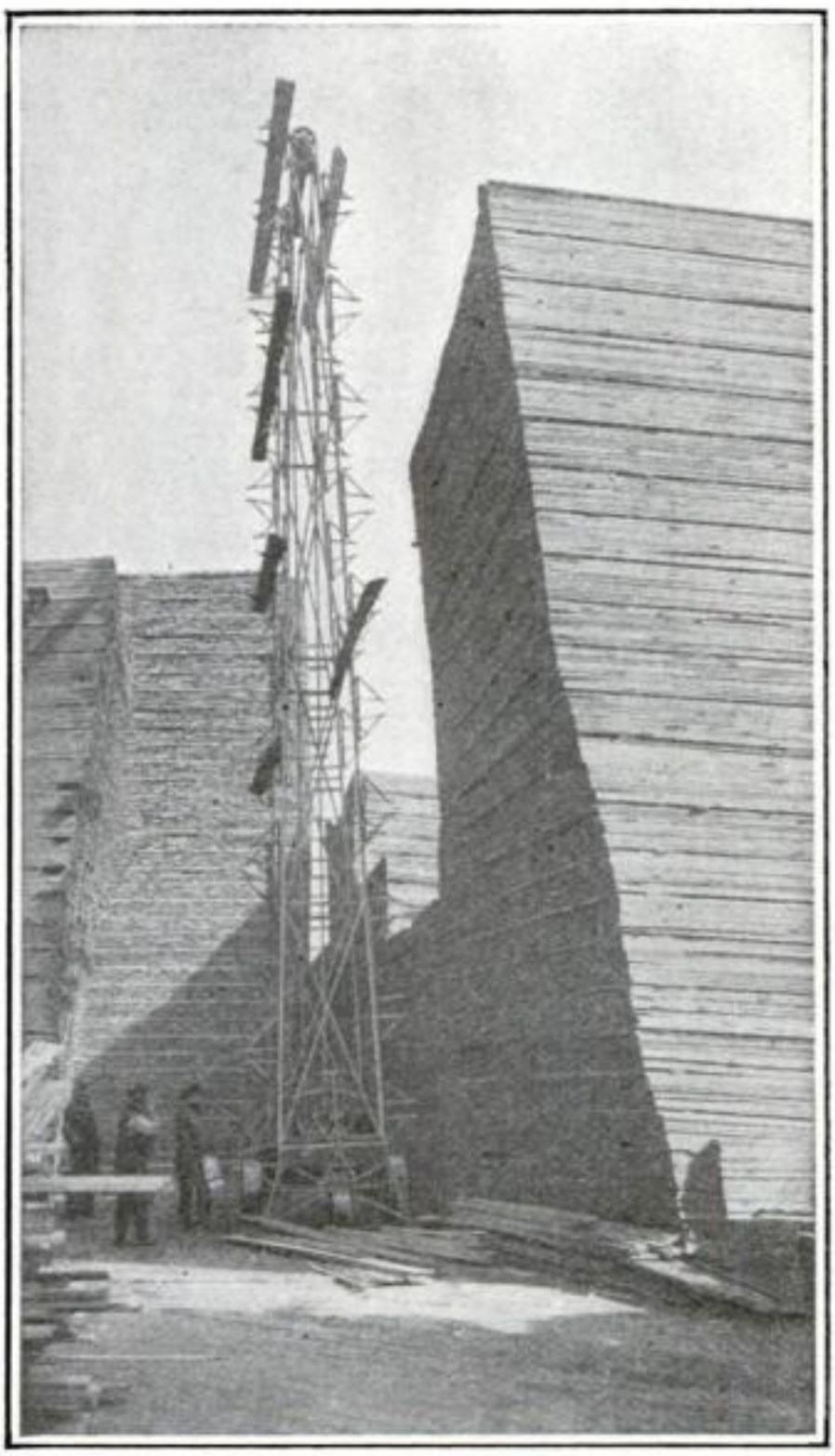


A trunk like this could be inspected by customs officers from the inside. It has its own electric lights

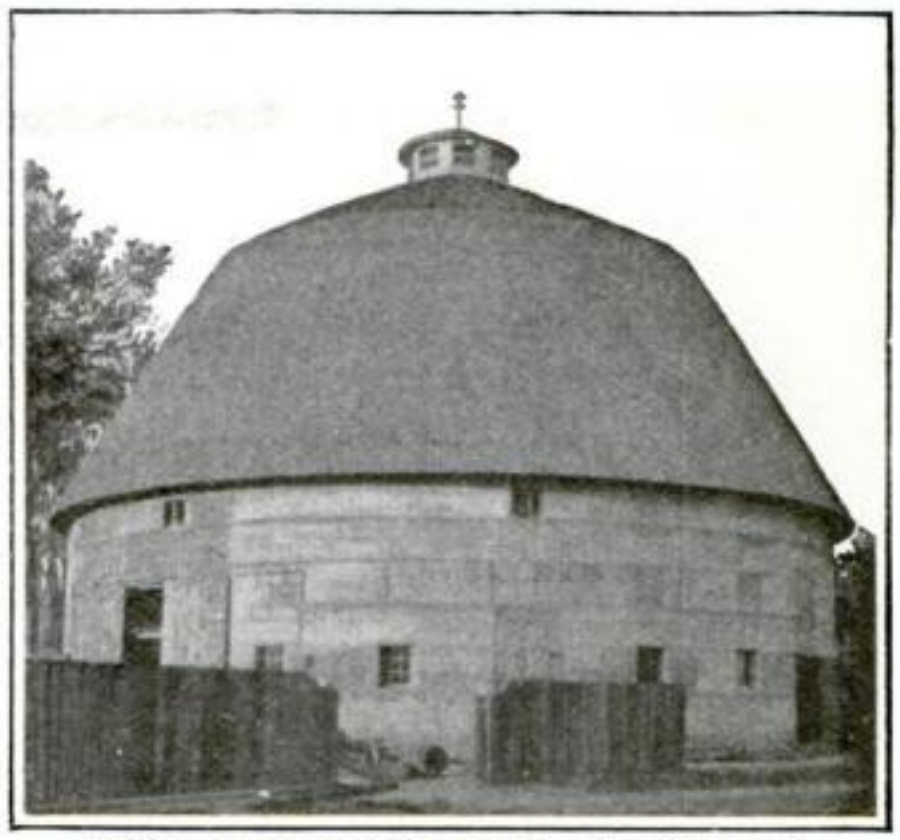
Piling Lumber in Forty-Foot Monumental Stacks

A MECHANICAL lumber-stacker which has recently been placed on the market has made possible a great saving in lumber yard space in our large cities. The *Edison Monthly* states that it is now possible to pile planks to the height of forty or more feet with a crew of four men, while in the past piles seldom reached a greater height than twenty-four feet.

The machine is electrically operated, and consists of a steel skeleton tower of the desired height, over which revolve two endless chains. Carriers are attached to these chains at short intervals. On these, planks are placed by workmen on the ground. Ten boards a minute are delivered by the carriers to the men on the top of the pile. One of these stackers is said to have piled one hundred and twenty-five thousand feet of lumber in ten hours.



This electric stacker will pile lumber forty feet high with perfect facility



This round barn is made of reinforced concrete, eight inches thick. The loft has neither beams nor posts

Circular Barn Built of Concrete

A PIONEER reinforced concrete, round barn, the first of its kind, and only one known to exist in the United States, has been completed on the farm of Harry McDaniel, near Dover, Del.

The barn is seventy-two feet in diameter and sixty-four feet high, the concrete walls being twenty feet high and eight inches thick, reinforced. It has a cupola five feet high and ten feet in diameter, with eight windows. It took thirty-one thousand shingles to cover the building.

The most remarkable part of the building is the loft, which has no posts, no beams, no girders of any kind. The loft has a capacity of about three hundred tons of hay. There is a circular track, thirty-five feet above the floor, used in conveying the hay to the remotest part of the loft.

The lower floor of the barn has thirty stalls for milch cows and eighteen stalls for horses, with a space in the center for twenty-five head of young stock. The building is two hundred and twenty-six feet in circumference.

ACCIDENT insurance is compulsory among the workmen in Holland, but other insurance is optional.

A back-yard swing and two hobby-horses made a new plaything for children

The Hobby-Horse Turned Into a Swing

A CHILD'S lawn swing with a hobby-horse for the chair, is the invention of a Missouri man (James W. Moore, of St. Joseph, Missouri). The hobby-horse is pivoted on a platform. It is connected with hangers, by which the platform is supported from the framework. The hobby-horse is rocked automatically by the oscillation of the swing, giving its juvenile riders a very agreeable thrill.

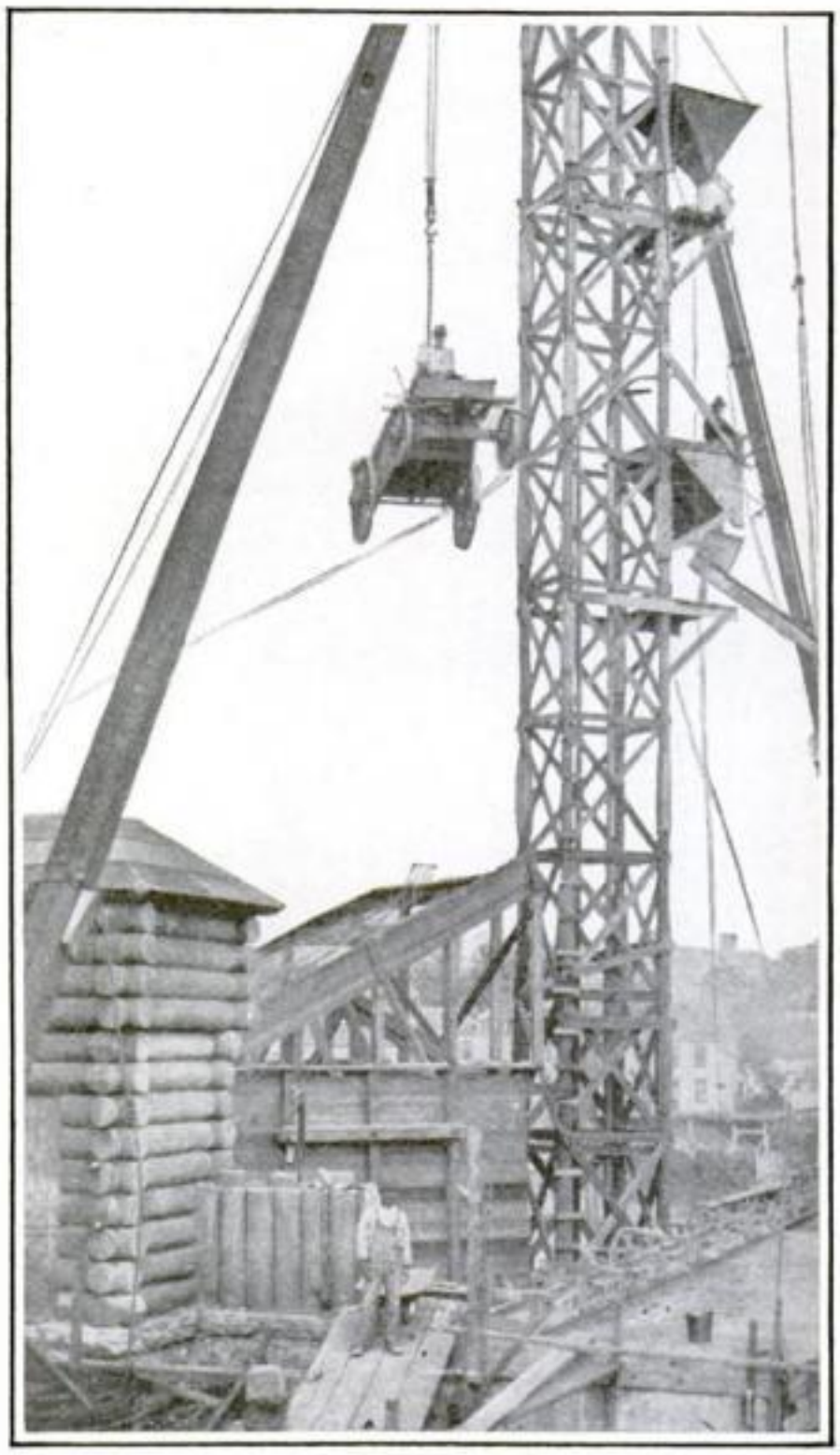
Lifting a Wagon to Dump Its Load

A NOVEL method of solving an unusual difficulty met by a contractor at Hamilton, Ohio, is shown in the accompanying illustration. Upon commencing his work he discovered that the gravel storage-hopper above the concrete-mixer was in an inaccessible location for the traffic. Owing to the street traffic there was no room for a gravel pile. It became necessary to resort to drastic measures.

When a gravel-wagon comes to the spot to discharge its load, the horses are unhitched and the wagon tongue is removed. Then a pair of hooks is attached to the front axle, and a pair of rings slipped over the hubs of the rear wheels. By means of a crane the wagon is lifted bodily over the hopper. Upon arriving at the desired location the driver pulls the dump lever and the load of gravel drops into the hopper.

A Shell That Melted Money in a Ship's Safe.

ONE of the most telling samples of the terrific effect of naval gun fire is a piece of metal recently taken from the hulk of the famous German commerce destroyer *Emden*. This souvenir consists of a lump of metal which was smooth on one side, but on the other side resembling a piece of jagged rock. The metal consisted of a portion of the fireproof safe of the *Emden* and some silver coins from a drawer in the safe. The explosion of a shell probably blew some of the dollars into the steel, the heat fusing the whole into a mass of iron and silver.



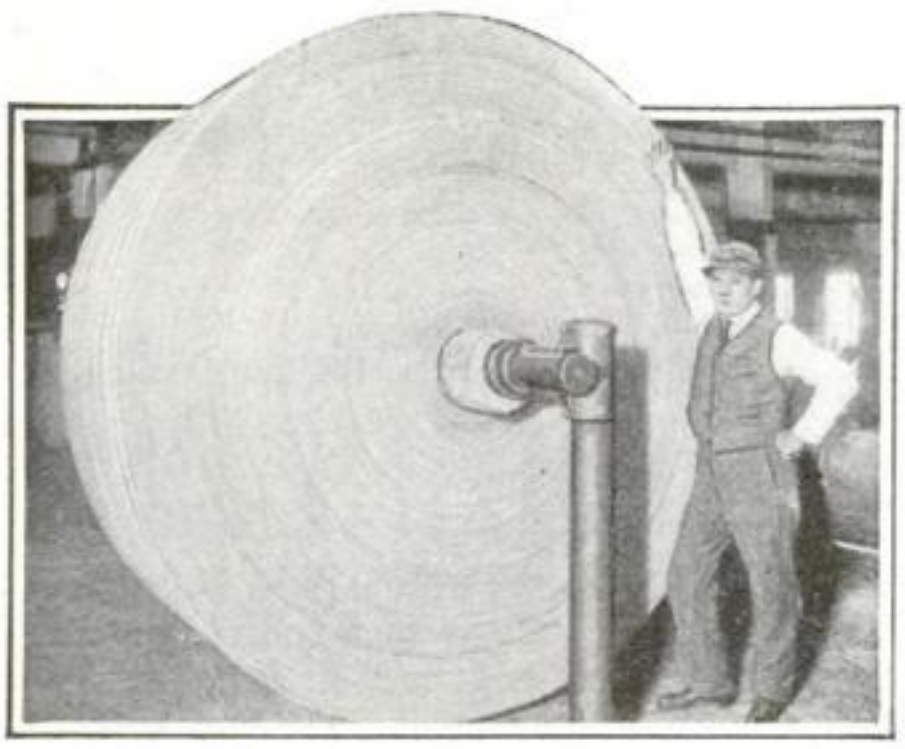
The wagon is raised bodily and its load dumped in the chute. The scheme saves shoveling or a conveyor system

This Belt Breaks All Records

A GIGANTIC conveyor-belt which has recently been installed in a California sugar refinery is said to have broken all records in the conveying of sugar. The belt is truly remarkable in size, being one thousand four hundred and forty-three feet long, thirty-six inches wide, and weighing nearly six tons.

In its operation this conveyor continually sustains a load of sixty bags of sugar, a total weight of seven thousand five hundred pounds. These bags are delivered to the belt every nine seconds and are carried to their destination at great speed, as the belt makes twenty-six complete revolutions every eight hours.

At the close of its service this belt will have exceeded the remarkable record established by its predecessor, which carried over two billion pounds of sugar before there were any evidences of wear.



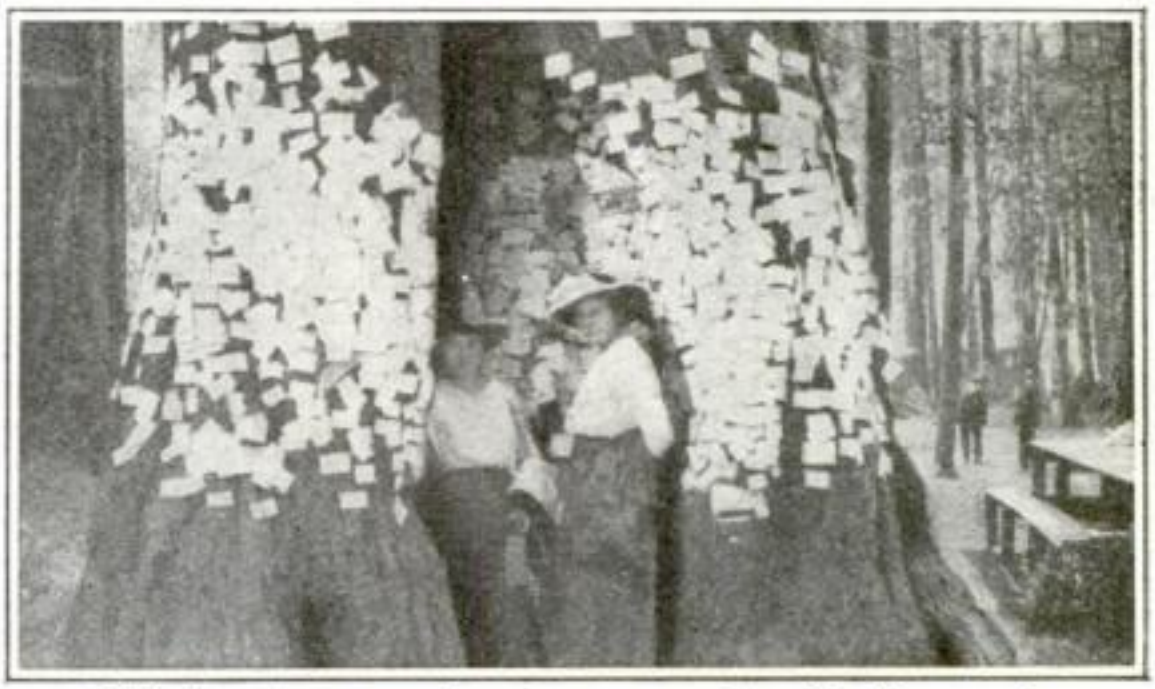
A belt which is destined to carry over two billion pounds of sugar before it wears out

Delivering Mail by Aeroplane

IN his annual report Postmaster General Burleson has recommended the appropriation of fifty thousand dollars for the establishment of aerial postal routes. He has submitted a list of routes over which much time could be saved by delivering the mail by aeroplanes instead of by railroad.

The Largest Card Holder in the World

THE tree in the accompanying picture is rightly named when it is called "the largest card case in the world" for it is literally plastered with thousands upon thousands of cards of all kinds.



This is where you leave your card, with thousands of others, to record your visit to the famous California redwoods

The tree is one of many in the famous redwood grove of big trees in the Santa Cruz mountains and is about eighty miles from San Francisco. Each year finds the tree covered with a fresh coat of calling cards, personal cards, business cards and other cards too numerous to mention. Not only is the outside made use of but the interior, which, due to some forest fire in the past is hollowed out into a large room, is thickly covered with pasteboards.

The exposition at San Francisco attracted more people to the grove than usual and a close observation will reveal the cards of foreign ambassadors, ex-presidents of the United States, Senators and so on down to the scrap of paper placed on the tree by a passing "knight of the road."

Although there are dozens of trees many times larger than this one, it is the only one used as a card-case.

WHEN the new water system of Madrid, Spain, is completed, it is estimated that the supply will exceed two hundred and six thousand gallons per minute, and that, in addition, there will be a hydro-electric production of twenty-one thousand horsepower.

Three Slender Wires Form a Bridge

THREE wires make a bridge in Maine. It is probably the cheapest one ever made, if the good old subterfuge of a log thrown across a stream is excepted, but it is as serviceable as concrete for spanning the fifty-foot creek over which it does duty. The bridge was built by a Portland electric light company for the use of the patrol maintained over its high-tension power lines, which run across country. Twice a day it is used by this one foot passenger.

Three hours a day are saved by the man who patrols this part of the transmission lines into Portland. Before its construction it was necessary for him to make a long detour to a road bridge in order to cross the creek. The stream is deep and cannot be forded. The bridge came after several row boats had been stolen by tramps and small boys.

Short telegraph poles were erected on each side of the stream, above the high water line, and light cables strung across; two waist-high and one for the feet. The patrol can get across in fifty seconds, grasping two wires with his hands and sliding one foot ahead of the other on the bottom cable. After his first attempt the patrol reported that he would not use the bridge, because he was no tango dancer. The wires sway back and forth and impart a rythmic motion, terrifying at first. But after a few times the patrol liked the sensation. Now he invites others to tango across with him.

Cross this fragile bridge and you will be so engrossed with the problem of maintaining your balance that you cannot admire the scenery

A Trolley Company Which Repairs Automobiles Damaged by Its Cars

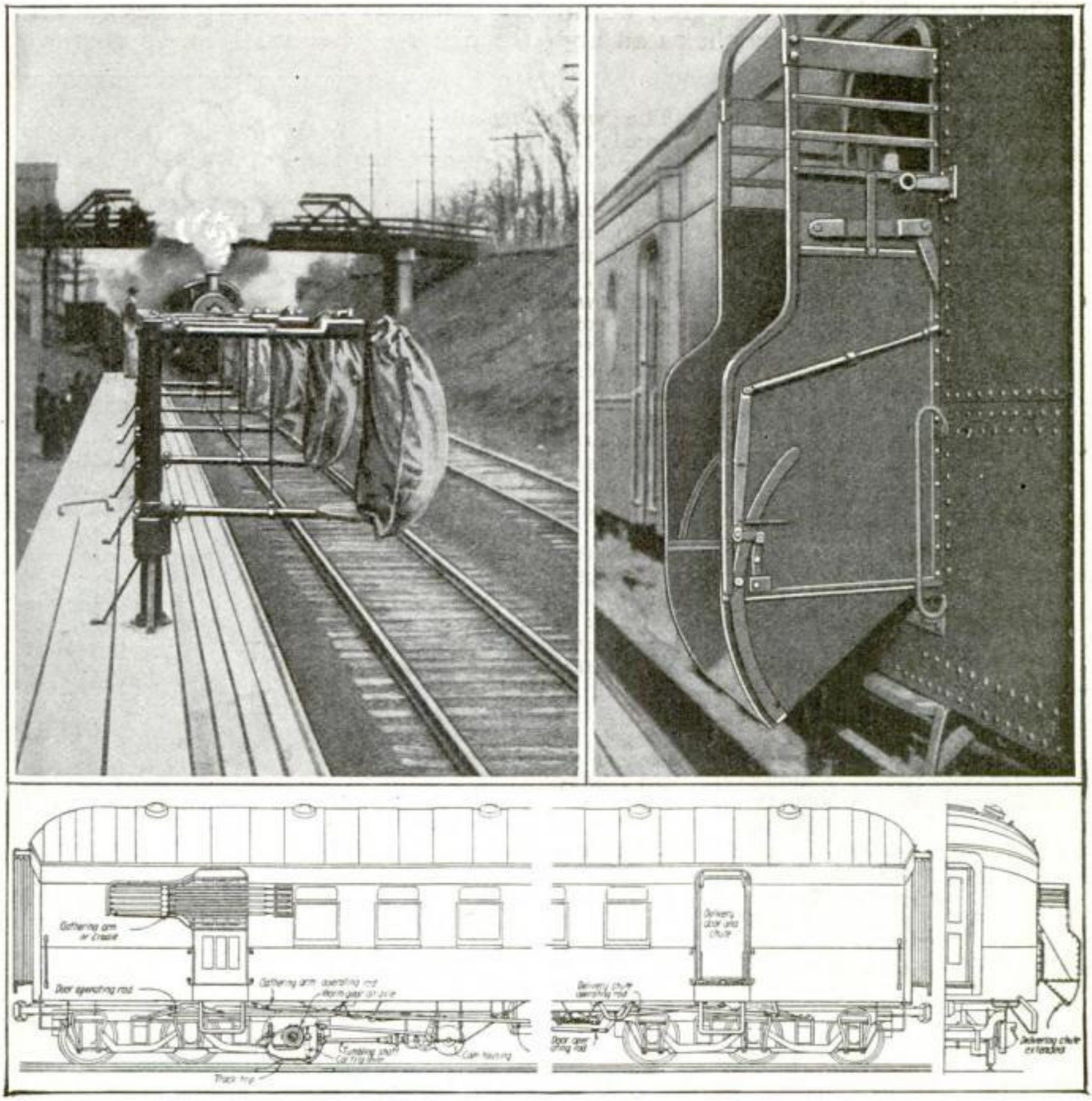
AN electric company which operates street cars in Iowa, finds it cheaper to repair motor cars damaged in collisions than to have the work done by an outside repair-shop. It is estimated that about fifty per cent of the expense of having this work done outside has been saved. Moreover, the practice is said to have gained the good will of those whose automobiles have been damaged. As it is, the company had a large number of cars in its own garage with a staff of repairmen. It was necessary only to add a few men to the regular staff to repair the damage caused by accidents.

Catching Mailed Eggs from Swiftly-Moving Trains

EGGS may now be delivered from a station platform and caught with ease and safety by the mail car of a fast-speeding express train, by means of an automatic mail exchange system recently adopted by a large western railroad.

This device works with great speed. When the train nears a station a lever on the truck of the mail car is operated by a track trip, thus setting in motion the system of cams which perform the functions of discharging and receiving the mail from the station.

A set of arms move out from the side of the car, and as the train passes, the suspended pouches of mail are caught by the arms and drawn into the car. Another cam, deriving its power from the car axle, picks up the mail pouches which are to be delivered at the station, and deposits them in a chute, where they slide into a trough on the station platform. This chute extends down until it nearly touches the platform, and the pouches fall but a few inches. They slide on the smooth surface of the trough until their fall is broken. As soon as the train has passed the station, the apparatus is automatically drawn inside the car and the doors are locked.



The much advertised delivery of eggs by parcel post has produced many patented devices for handling mail sacks without breakage. This one is already carrying eggs

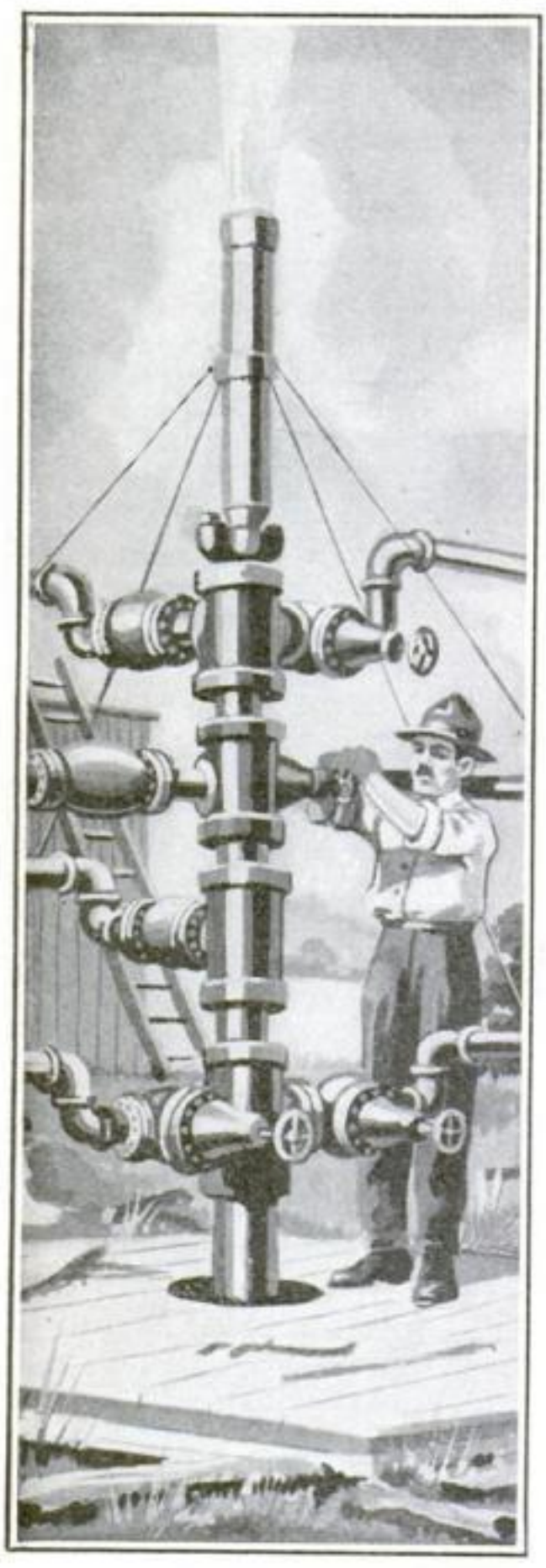
A Gas Well Which Wasted $200,000

By Harry Knowlson

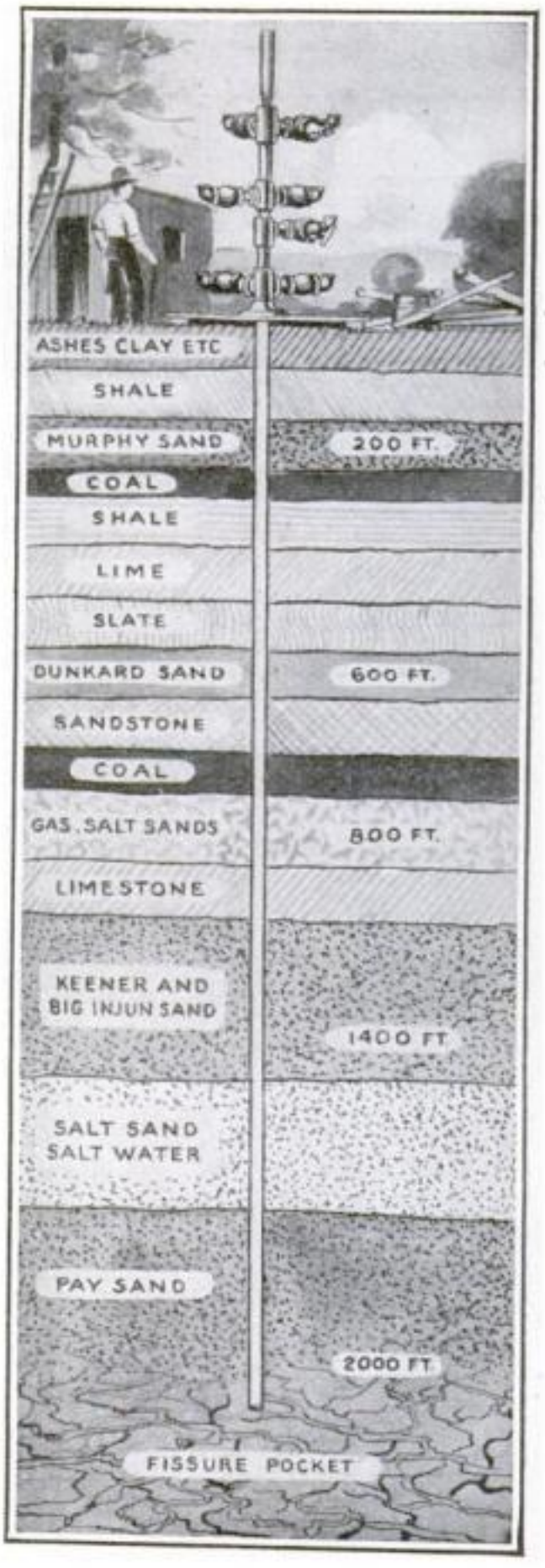
"BLOWING WILD" with a deafening roar for over a week and wasting upwards of two hundred thousand dollars of natural gas is the record of the largest gas well ever drilled in Pennsylvania. The Spiegel well—for it was named after the owner of the land—is in Versailles Township, near East McKeesport, Pa., that is, in the "Pittsburgh district," a section rich in "pay sand," which has produced several notable gas wells.

This remarkable gas well goes down into Mother Earth as straight as an arrow for two thousand feet. In that region geologists say there is a layer of sand permeated with natural gas. Once an opening is made in the earth's crust, the gas rushes upward with terrific force.

Between six hundred million and eight hundred million cubic feet of natural gas were lost before the well could be capped and the flow controlled. Almost immediately after workmen struck the "pay sand," the gas rushed forth with such destructive force that it demolished the wooden derrick used in connection with the drilling. Several laborers narrowly



The workmen who bored this well sent their drills down two thousand feet through ledge after ledge of earth and rock to tap the fissure pocket full of gas. When the pocket was opened, the gas, confined under those two thousand feet of earth and rock, burst out to the surface, demolishing the derrick and nearly killing the workmen. Over six hundred million cubic feet of gas escaped before the cap was put on and its stop-cocks closed. The cap was of heavy steel, with six valves, all of which were of course left open until the cap was in place, when they were closed. The loss of gas before the process was complete was estimated at $200,000. Great care had to be exercised during the week that the gas escaped unchecked. No lighted matches or other flames were permitted within a great distance of the well. The family living near by were obliged to forego cooking and had to go to bed without light



escaped being killed. Thereafter, for more than a week, the flow of gas continued unabated in quantity and pressure.

This gigantic "gasser" was capped eventually with a long piece of steel tubing, larger in diameter than that in the

The gas blew off at a pressure of one hundred feet per square inch three feet above the outlet

well, and having six valves on the sides and another on top. Of course these valves were left open while the tubing was being placed in position and made secure to the casing in the well, to which it was attached by threads. One at a time, the valves were closed until a pipe was fastened to each to carry off the gas to a reservoir. As soon as the pipe was attached to a valve that one was opened again, so as to relieve the enormous gas pressure. Thus the entire flow was harnessed and taken away for consumption in the neighboring locality and nearby towns.

After considerable difficulty and several unsuccessful attempts, a venturesome engineer finally succeeded in measuring the flow of gas. When a gage was applied a few days after the well struck "pay sand" and the flow of gas was at its height, it was found that there were one hundred pounds open flow three feet above the outlet. And on this measurement the estimate of seventy-five million to one hundred million cubic feet of gas per day was based. The men on duty continuously suffered severely from earaches because of the terrific noise made by the outrushing gas. Fortunately, there was no electric storm or the well might have caught fire. Had this happened, the blaze could not have been extinguished. While the gas was flowing freely, the Spiegel family, living in a house within thirty yards of the "gasser," had to forego cooking and all went to bed at sunset because they dared not have a light.

The value of the lost gas was estimated at the Pittsburgh rate of thirty cents per one thousand. This means a daily loss of not less than twenty-two thousand, five hundred dollars. The actual value may be more, since higher rates obtain in other cities. Since the well ran for seven days and twenty-one hours before it was checked by capping, the minimum total loss was one hundred and fifty-seven thousand dollars. Others put it at close to two hundred thousand dollars.

Why Can a Fly Walk Upside Down?

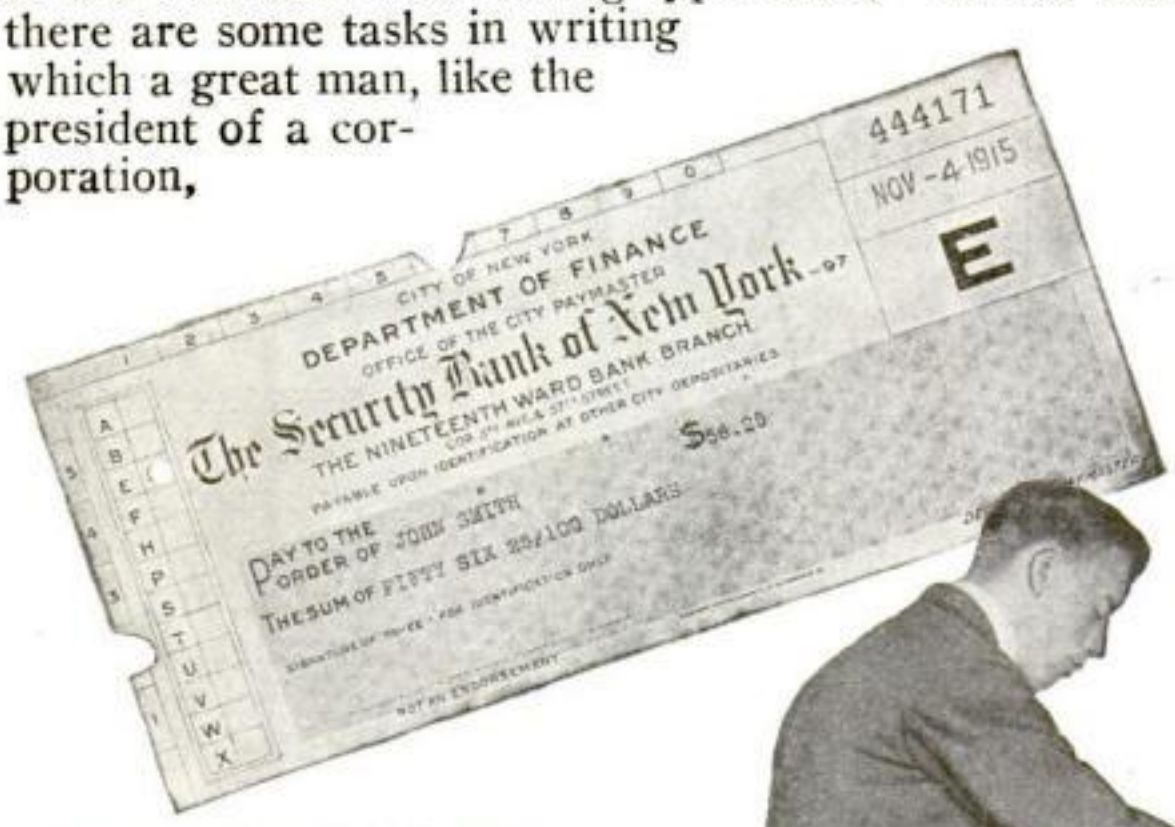
YOU have seen a boy use what he calls a "sucker," a round, flat piece of leather which is soaked in water and flattened against a stone so that all the moisture between the stone and the leather is pressed out. He picks up a brick with a string attached to the leather. Since there is no air between the leather and the stone the atmosphere presses the leather so firmly against the stone that the stone can be picked up by the leather.

A fly has suckers on his feet which act very much on the same principle. As soon as he puts down a foot he automatically squeezes the air out between it and the surface upon which he is walking. The atmosphere, therefore, presses him against the ceiling or wall.

Spending Money by Machinery

By Herbert Francis Sherwood

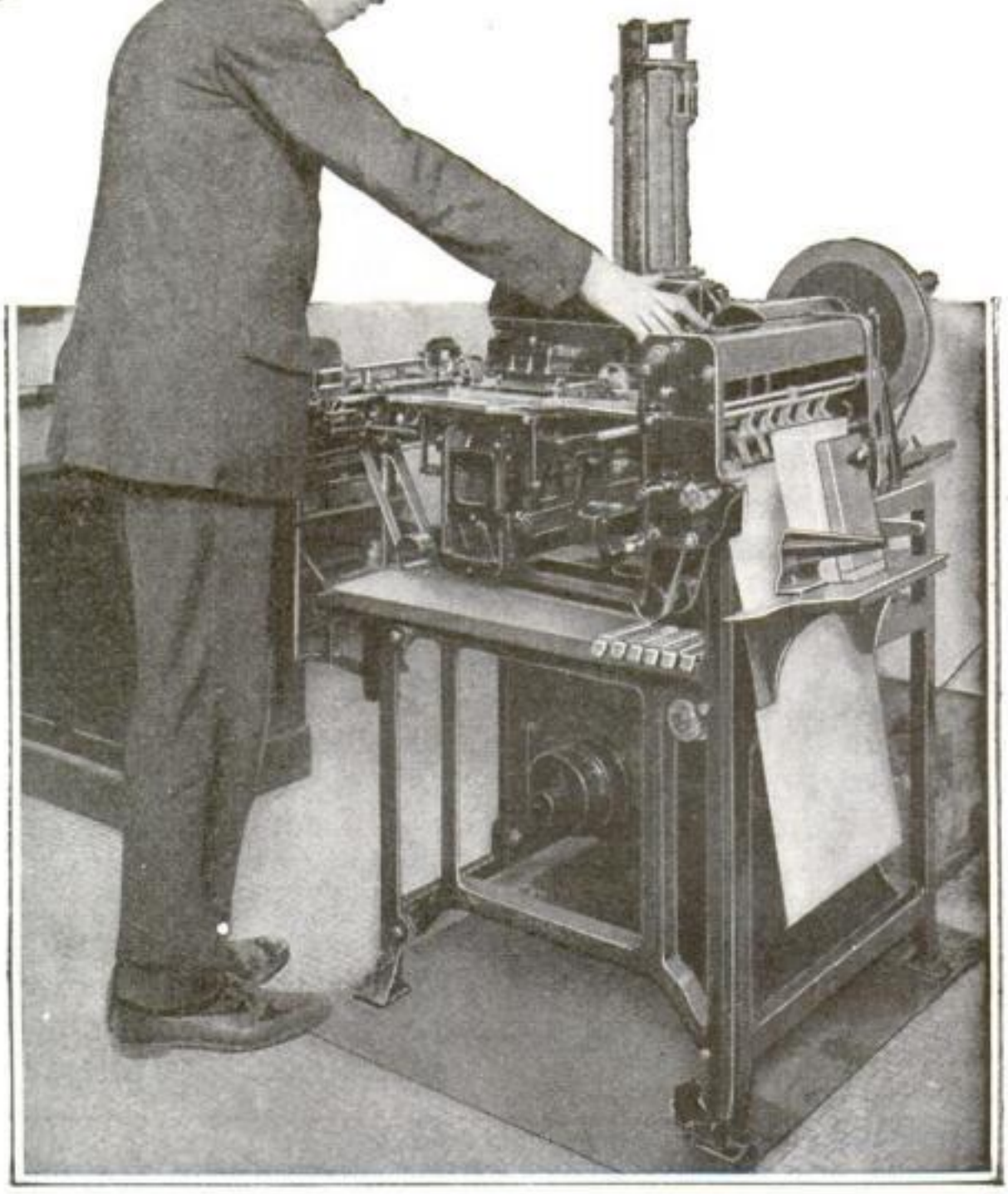
THERE were no commercial typewriters in Abraham Lincoln's day. The great President often wrote his letters himself. Even with the invention of the time and labor-saving typewriter, there are some tasks in writing which a great man, like the president of a corporation,



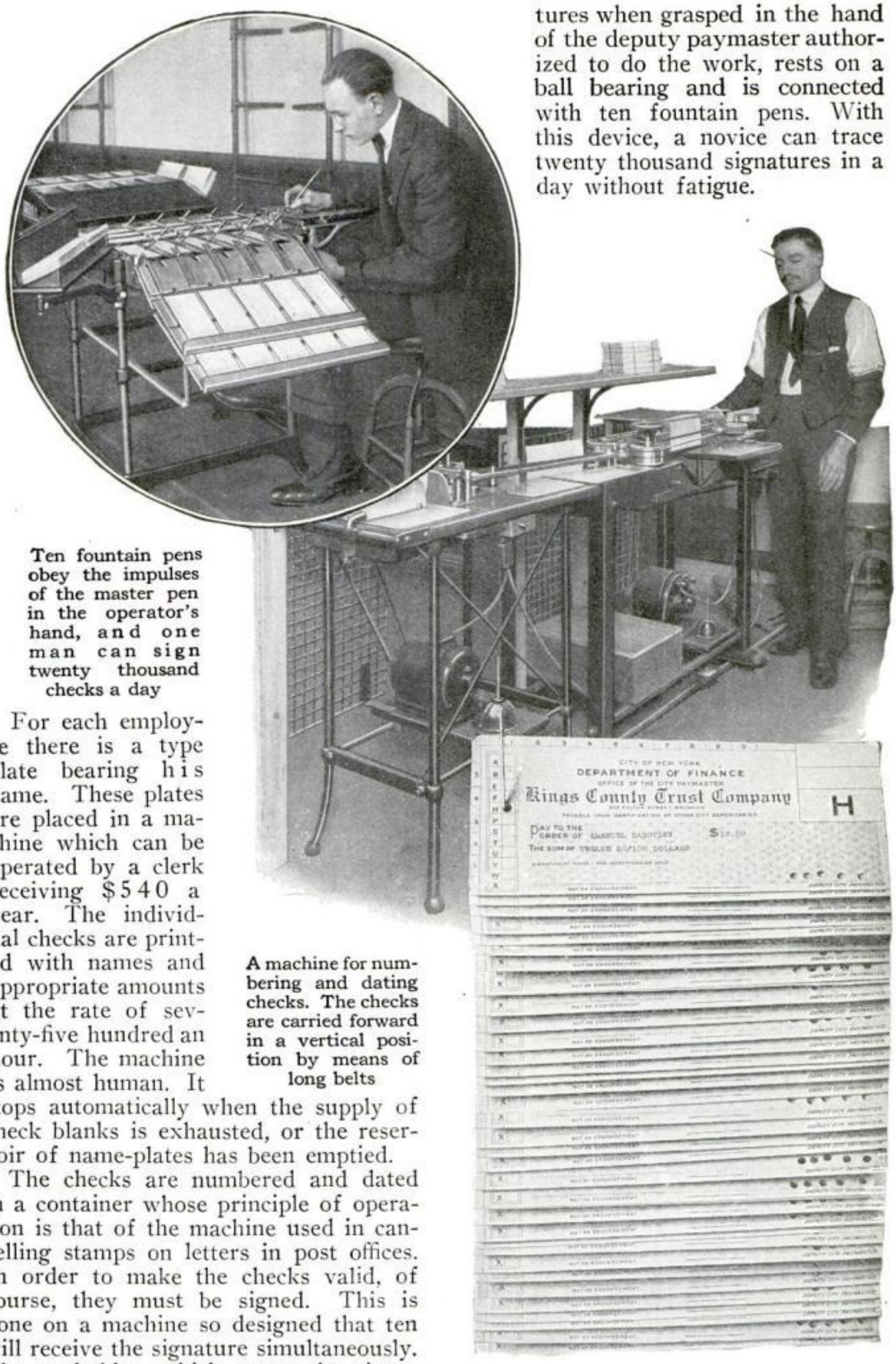
One of New York's new pay checks which are printed, filled in, and signed by machinery

could not well leave to subordinates and which were impossible of accomplishment on a machine. Such are the signing of checks and the signing of stock certificates and bonds. The average executive accustomed to the signing of papers, cannot, without fatigue, attach his name to more than twenty-five hundred in a day. In these times, when governments and corporations issue bonds representing millions upon millions of dollars, and have payrolls carrying thousands upon thousands of names, the task of signing a name in some cases has become an indescribable drudgery. Yet it must be done by responsible persons whose time is especially valuable.

One of the greatest corporations in the world is the municipality of New York. It has more than ninety thousand employees receiving more than one hundred and five million dollars in wages and salaries in the course of a year. In 1915 the finance department of this corporation introduced a method of filling out pay checks and signing them by machinery, and thus saved seventy-five per cent in cost, and accomplished work formerly requiring more than sixty office-holders.



The electric machine which fills in the checks with the name and amount at the rate of seventy-five hundred an hour or about twenty per second



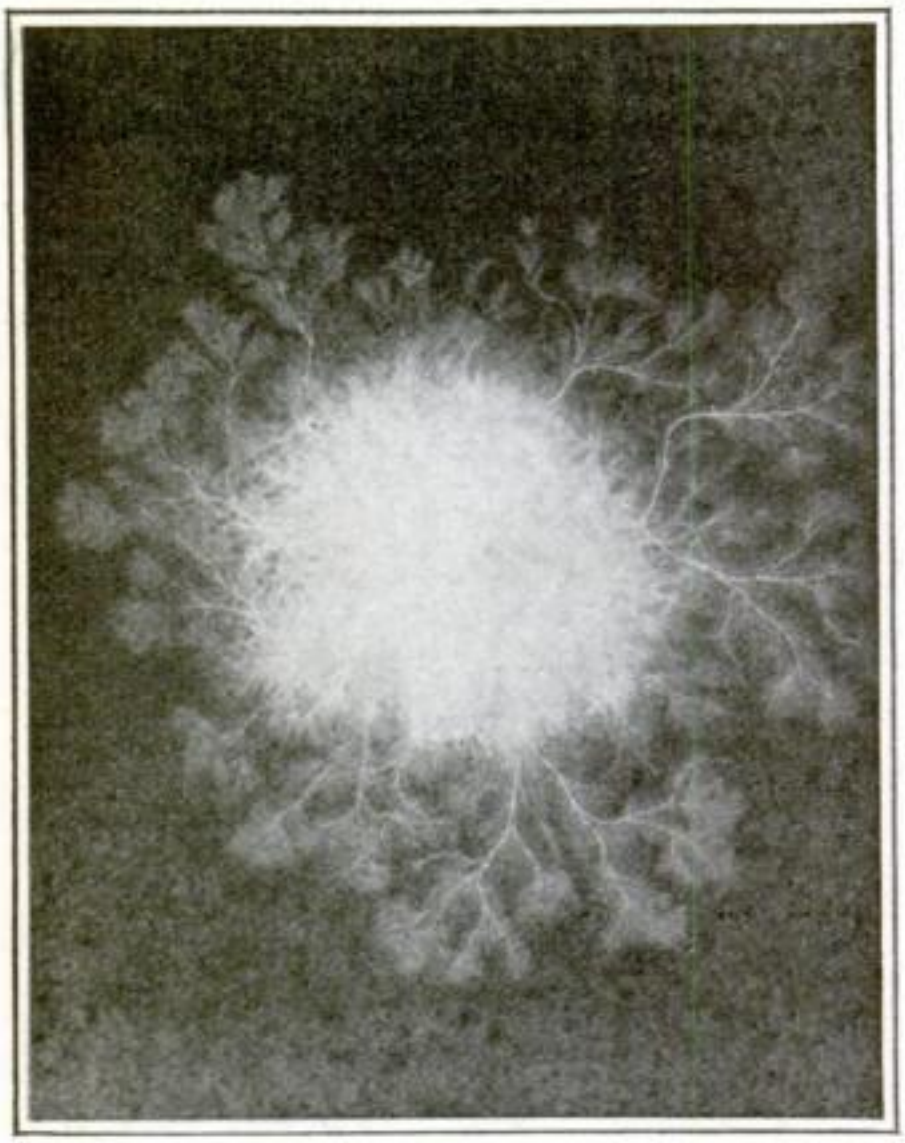
tures when grasped in the hand of the deputy paymaster authorized to do the work, rests on a ball bearing and is connected with ten fountain pens. With this device, a novice can trace twenty thousand signatures in a day without fatigue.

Ten fountain pens obey the impulses of the master pen in the operator's hand, and one man can sign twenty thousand checks a day

For each employee there is a type plate bearing his name. These plates are placed in a machine which can be operated by a clerk receiving $540 a year. The individual checks are printed with names and appropriate amounts at the rate of seventy-five hundred an hour. The machine is almost human. It stops automatically when the supply of check blanks is exhausted, or the reservoir of name-plates has been emptied.

A machine for numbering and dating checks. The checks are carried forward in a vertical position by means of long belts

The checks are numbered and dated in a container whose principle of operation is that of the machine used in cancelling stamps on letters in post offices. In order to make the checks valid, of course, they must be signed. This is done on a machine so designed that ten will receive the signature simultaneously. The penholder, which traces the signa-



To photograph a spark like this is no feat of simple "snap-shot" work. It takes some preparation, but it can be done by any careful experimenter

How to Photograph Electrical Sparks

THE following experiments can be performed with a ¼″ spark-coil. The ordinary photographic plate is used in all cases, its size depending on the objects. The experiment is conducted in a darkroom or in a room lighted only with a ruby photographic lamp. Any white light will spoil the plates instantly. After exposing the plates they must be developed.

Take a small bottle with a wide mouth and fill it half full of any talcum powder. Over the mouth place a thin piece of gauze to act as a fine sieve. Tie the gauze around the neck of the bottle with a fine string. Place the photographic plate on a metal plate with the coated side up. Connect the metal plate with one of the secondary posts of the spark-coil. Sift a thin layer of the talcum powder over the photographic plate. Now place a very fine metal point in the middle of the plate (a pin is excellent). Connect the pin with the other post of the coil and make *one* spark, lasting one second or less. Wipe off the powder and the plate is ready for developing.

Trimming Veneered Edges by Electricity

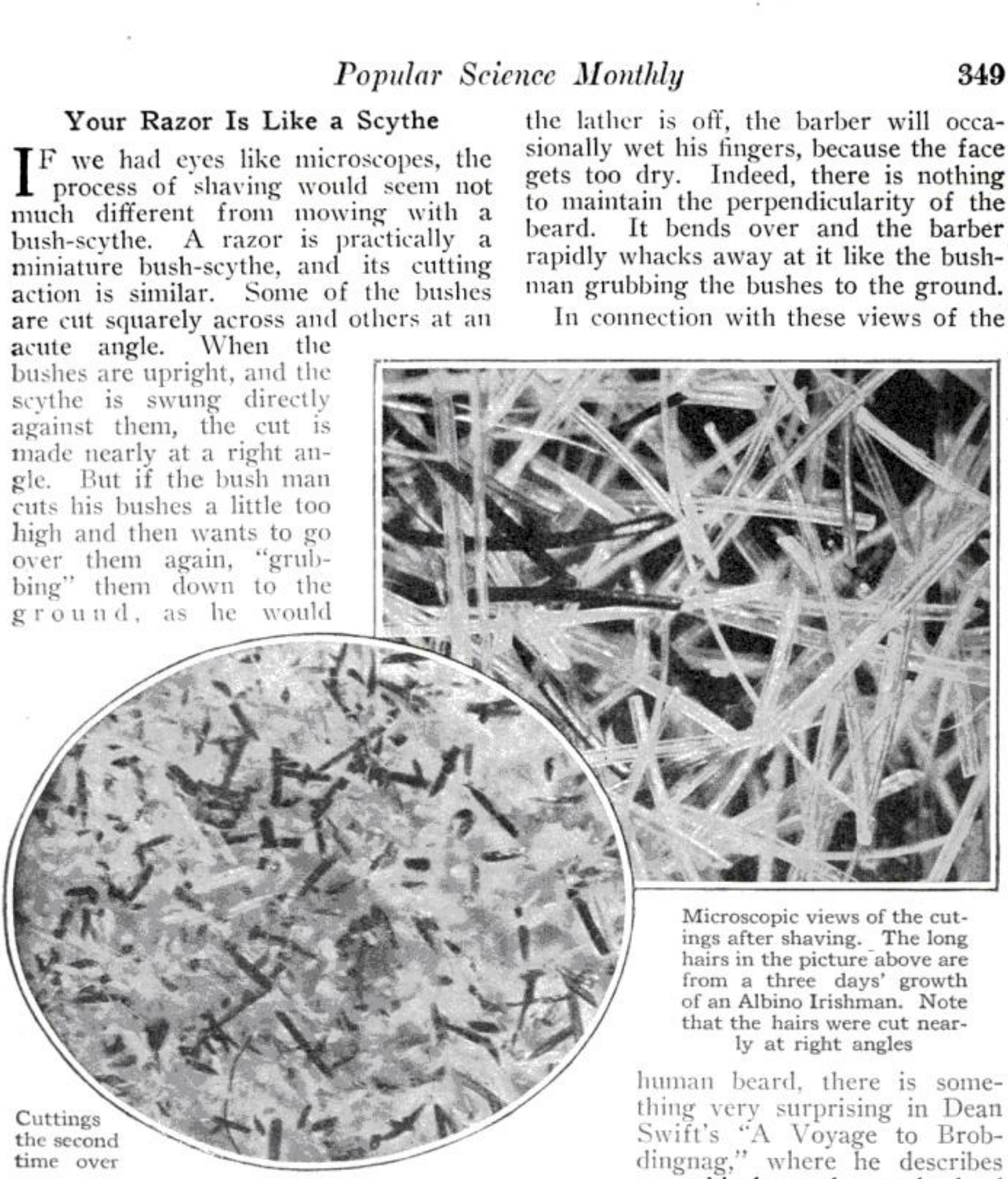
IT has been the custom to trim the edges of veneered work with a drawshave or rasp, but this is always accompanied by danger of injury to the work. The importance of having veneered work perfect has prompted a manufacturer to bring out an electric-trimming device, which makes injury to the work impossible.

Built within an aluminum case, which protects the saw on all sides except the cutting edge, is an electric motor. This drives the special saw for trimming the veneered edge at very high speed and makes possible the perfect removal of the delicate wood and the glue as well. The saw is adjustable to any height by means of a screw, so that the veneer may be removed flush with the work or the edge extending to any desired height. Power is supplied from a lamp-socket.

A boy can operate this electric planer (for it is nothing else). The concentrated power of electricity makes perfection easily attainable by the modern workman

Your Razor Is Like a Scythe

IF we had eyes like microscopes, the process of shaving would seem not much different from mowing with a bush-scythe. A razor is practically a miniature bush-scythe, and its cutting action is similar. Some of the bushes are cut squarely across and others at an acute angle. When the bushes are upright, and the scythe is swung directly against them, the cut is made nearly at a right angle. But if the bush man cuts his bushes a little too high and then wants to go over them again, "grubbing" them down to the ground, as he would phrase it, especially if the bushy stumps are in a marshy place where the ground does not hold them firmly, he strikes at them several times in succession, and the cut is likely to be more and more at a slant, depending upon the resistance with which they hold their own in the ground.



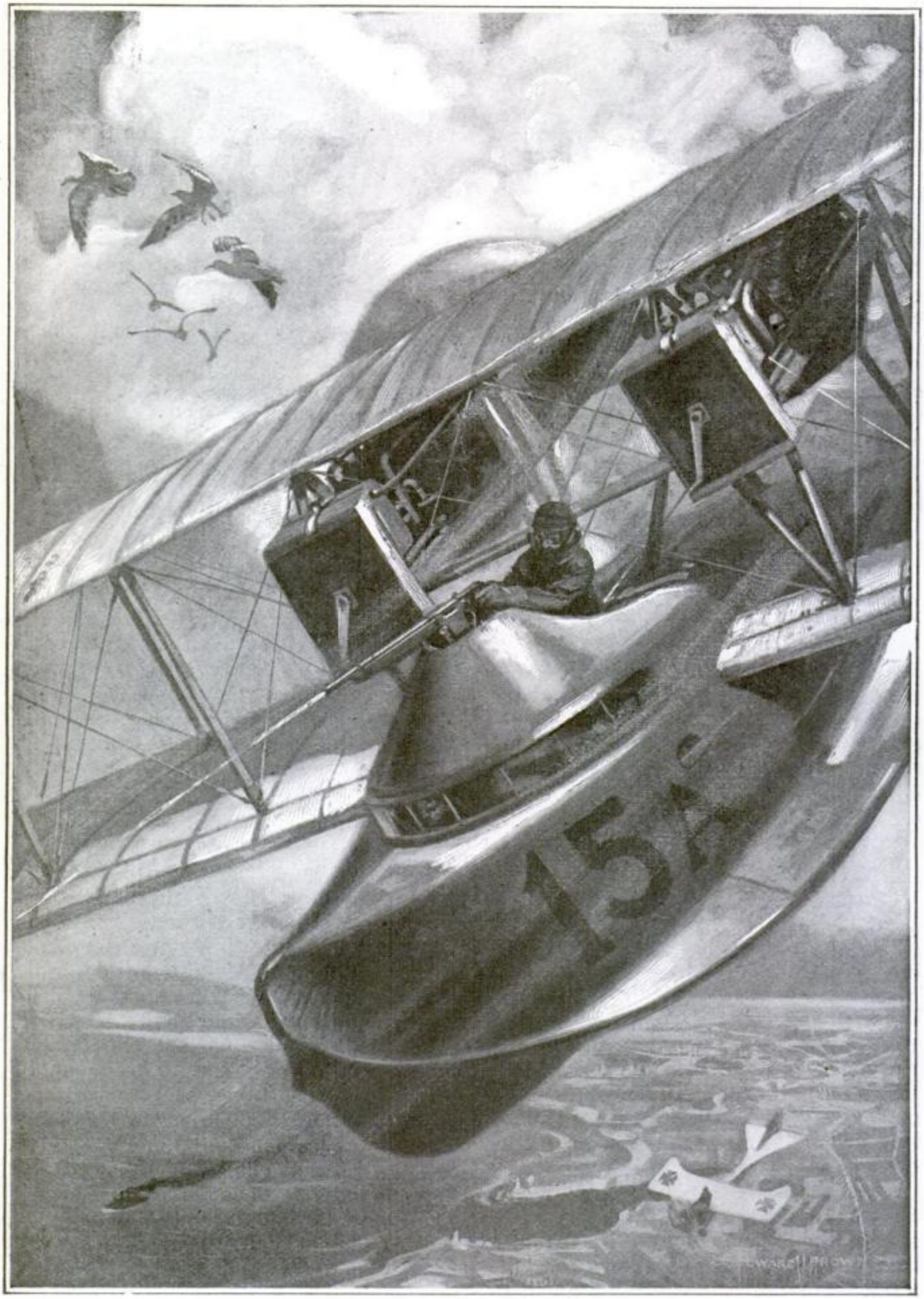
Cuttings the second time over

Microscopic views of the cuttings after shaving. The long hairs in the picture above are from a three days' growth of an Albino Irishman. Note that the hairs were cut nearly at right angles

When the barber applies a heavy coat of lather to a long beard, the lather tends to hold the hair upright. In the first shaving, the microscope shows that the cuttings are nearly at a right angle to the length of the beard, but the "second time over," when the call is for "a close shave, Mr. Barber," short rapid strokes are made, several times repeated. When the lather is off, the barber will occasionally wet his fingers, because the face gets too dry. Indeed, there is nothing to maintain the perpendicularity of the beard. It bends over and the barber rapidly whacks away at it like the bushman grubbing the bushes to the ground.

In connection with these views of the human beard, there is something very surprising in Dean Swift's "A Voyage to Brobdingnag," where he describes a mythical traveler to the land of the giants and what he had to say of giants' beards. He writes:

"I used to attend the king's levee once or twice a week, and had often seen him under the barber's hand, which, indeed, was at first very terrible to behold: for the razor was almost twice as long as an ordinary scythe. ....I once prevailed on the barber to give me some of the suds or lather, out of which I picked forty or fifty of the strongest stumps of hair. I then took a piece of fine wood, and cut it like the back of a comb, making several holes in it at equal distances with a needle....I fixed in the stumps so artificially, scraping and sloping them with my knife towards the points, that I made a very tolerable comb which was a seasonable supply, my own being so much broken in the teeth, that it was almost useless."



Hovering over the battle lines in Europe are battle 'planes of great size. The engines turn over slowly, giving the 'planes a lazy speed of sixty miles an hour. When a machine rises to fight them off a sudden transformation takes place. Powerful engines are switched on, and at tremendous speed the birds of prey rush to the battle, with their guns belching fire

Destroyers of the Air

By Eustace L. Adams

An all steel battle aeroplane, manufactured near Boston. These machines may revolutionize the aeronautical industry, since, with proper machinery, they may be stamped out in almost unlimited number. They will doubtless be models for pleasure craft

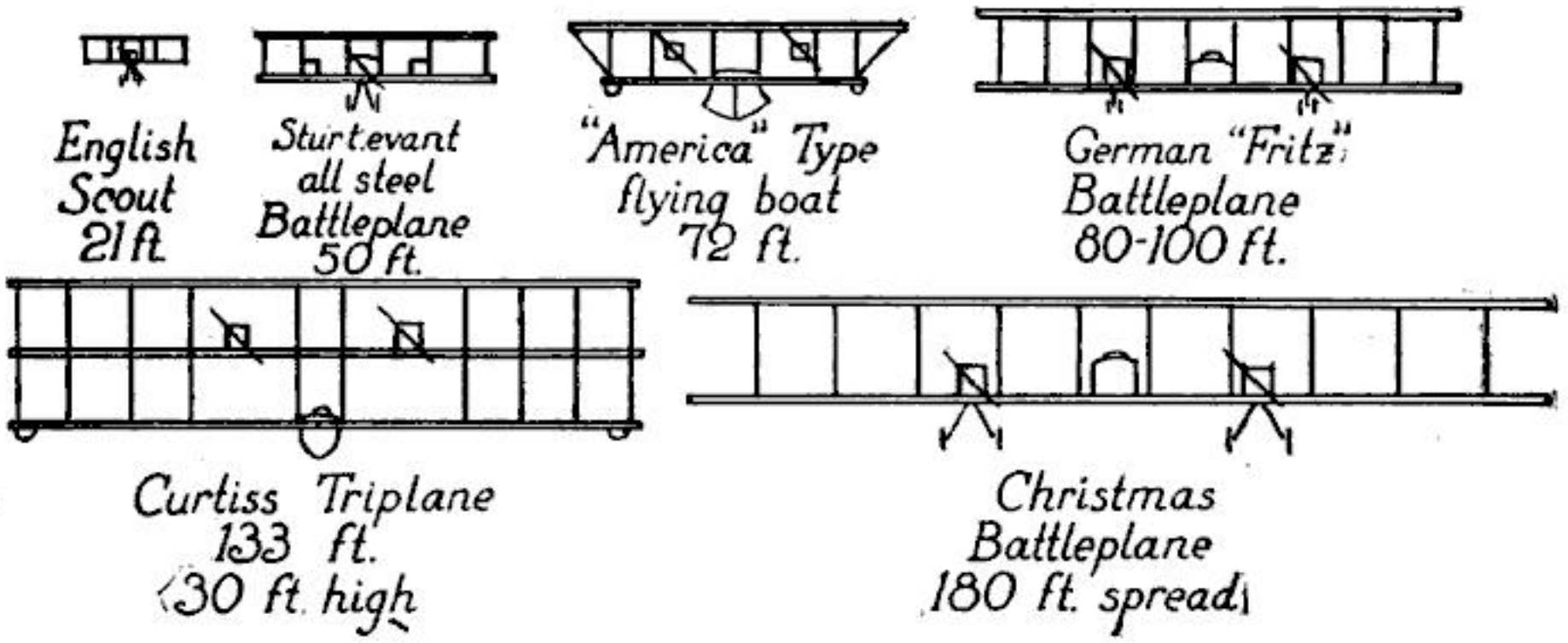
THE navy with the greatest number of super-dreadnoughts wins in a modern naval engagement. Since the launching of the *Dreadnought*, which gave the type its name, the nations of the world have been feverishly engaged, attempting to outdo one another in the building of great sea fighters.

The race for supremacy in dreadnoughts and super-dreadnoughts of the air is as keen at this moment as the race for supremacy on the water. Armies are finding that if they have no giant aeroplanes to drive away the armored battle-planes of the enemy they are fighting under an almost impossible handicap.

France, England, Russia and Germany have all developed their aerial dreadnoughts during the last year of fighting, and the development of the aeronautical industry has progressed the equivalent of many years during the last twelve months, measured by past progress. Those who have seen aviators "loop the loop" and break records at aviation meets and country fairs, can form but a slight conception of the huge machines now hovering over the battlefields of Europe. Giant aeroplanes, heavily armored, and carrying a crew of several men, ward off attacks with two or three guns, shooting high explosive shells in an aerial contest. They are capable of remaining in the air for several hours. Were they devoted to peaceful pursuits, they could carry mail and passengers almost with the certainty and regularity of an express train.

Although Americans have never seen these machines, this country is playing no small part in developing the battle-plane of today and the aerial express of tomorrow. Two builders of aircraft in the United States are reported to be constructing aeroplanes which will be among the largest that the world has ever seen. The average exhibition aeroplane with which most of us are familiar measures about thirty feet from tip to tip. A company with factories in Washington is said to be manufacturing some aeroplanes which have a wing span of one hundred and eighty feet. Heavily armored with steel, and carrying a two-inch gun in each of its two fusilages, each great machine will be driven through the air by two motors developing sixteen hundred horsepower together.

Immediately before the outbreak of the war, the eyes of the world were upon a flying boat named the *America*, built for the first trans-Atlantic flight, but destined to cross the ocean in the hold of a steamship, to play an important part in British operations against enemy submarines. The *America* was one of the pioneers of the present battle-planes. Equipped with two motors, and with a comfortable cabin for the operators, this



Showing the growth of the aeroplane and the comparative sizes of the more important machines now in use or building. The first shown, the scout machine, is very little smaller than the standard size 'planes in use in the United States. Compare it with the others, and an idea may be gained of the great progress recently made in this infant industry

aeroplane was at the time a distinct advance over anything previously built. Under war conditions this machine proved so successful that Glen H. Curtiss is now building them at the rate of one every day.

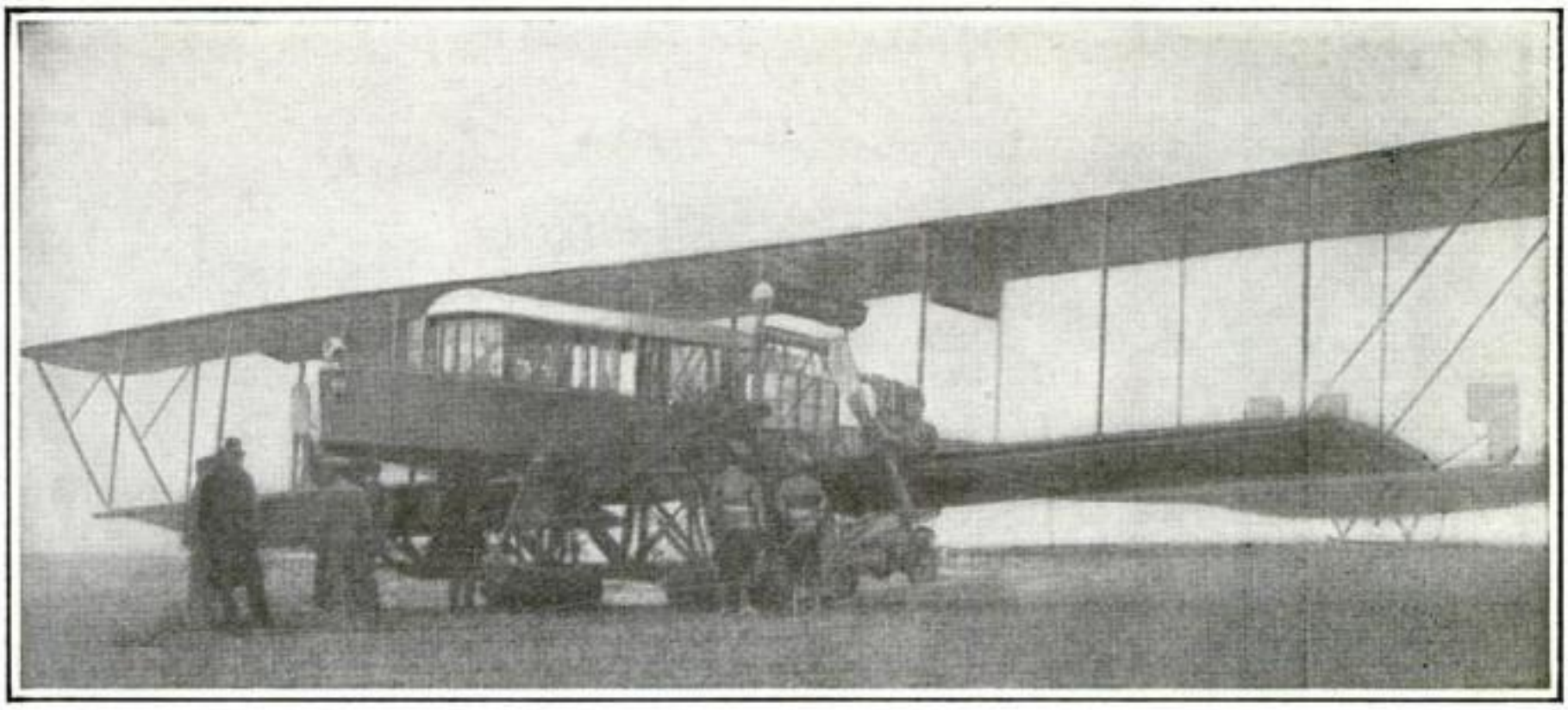
The *Canada*, a land machine, was the next aeroplane of note designed by Curtiss. Machines of this type are all manufactured in a Canadian factory, and the plans are sedulously kept from the public. Reports from Canada indicate that these aeroplanes have an eighty-foot wing span, and are able to carry two guns and one ton of explosives. Trial flights made at the testing grounds have resulted in speeds but little under one hundred miles an hour, since the machine is equipped with two motors of great power.

The newest designs of Curtiss call for a triplane, with a wing span of one hundred and thirty-three feet. This great flying boat weighs, fully equipped, nearly eleven tons. When on the water it is driven by a propeller similar to those used on large motor boats, but when it is to be lifted into the air, the great power of its two heavy engines is transmitted directly to the aerial propellers, and the huge machine rises like a seagull. A crew of several men is sheltered by an ample cabin, and a number of guns project from the sides of the compartments. The speed of this craft is probably high, and its cruising radius, when fully loaded, should be about six hundred and seventy-five miles.

European War-planes of Huge Dimensions

From the haze of the European war fronts come reports of aeroplanes which transport unheard-of weights for many hours, and which carry large crews to operate machine guns and cannon, but the censors have been remarkably successful in suppressing all definite news of these marvels.

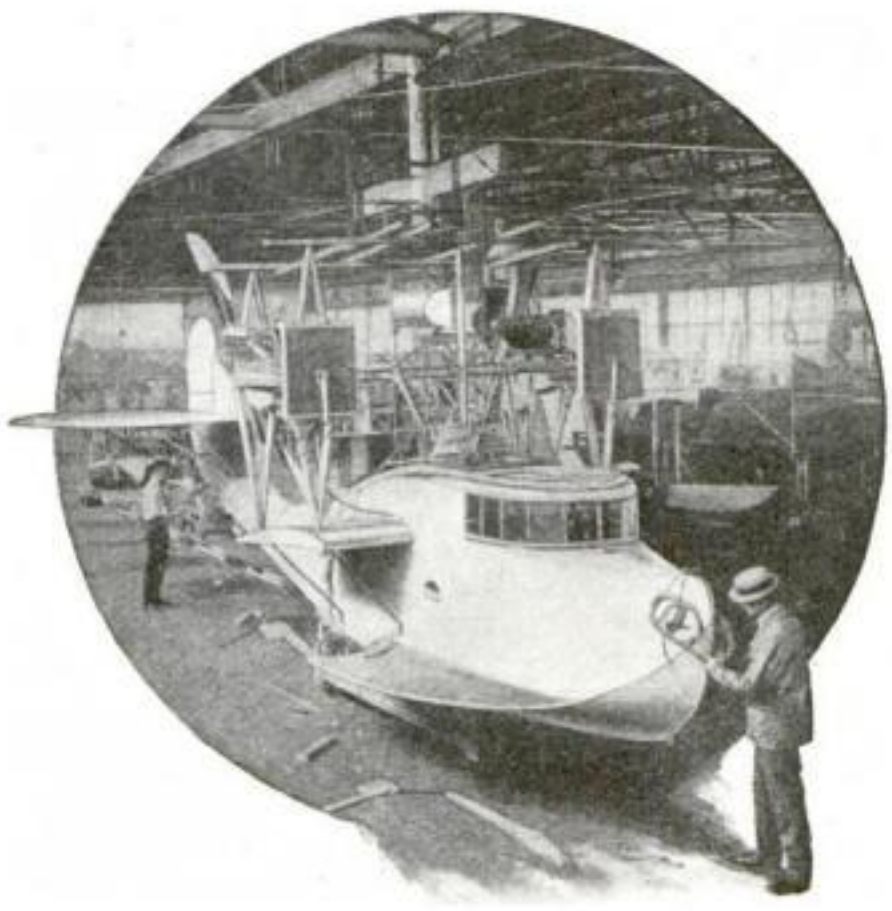
Before the outbreak of war the Sikorsky biplane, a Russian machine of great size, had startled the world by making successful flights with seventeen passengers. Luxurious accommodations were provided for the guests, and meals were served in the air. This machine, while propelled by four Salmson motors of five hundred horsepower each, had the great disadvantage in war times of being slow, since it could fly but little more than fifty miles an hour. Little has been heard of this aeroplane since it was converted into a battle-plane, but it is certain that numerous machines of similar size and design have been added to the Russian aerial fleet, and that the speed has undoubtedly been greatly increased. The luxurious passenger compartments have been remade into cabins for gunners and bomb droppers, and gun mounts now take the places once occupied by comfortable chairs and dining



The Sikorsky biplane, the first of the aeronautical giants of to-day. Before the outbreak of war, this machine startled the world by making successful flights with seventeen passengers

tables, luxuries replaced by explosives.

With the exception of the Sikorsky biplane, the first reports that filtered into the press of both continents concerning aerial dreadnoughts was the appearance over the English lines of a huge German machine, which hovered at a great height over points of vantage, refusing to be driven away by anti-aircraft guns. The engines turned over slowly, driving the biplane at a lazy speed of sixty miles an hour. British aviators who rose to fight off this stranger were received with a hearty welcome. Powerful motors were switched on, and the machine flew to the combat at a tremendous speed. From the fusilage two guns blazed forth, and the hardy British were quickly driven to cover. For some time this machine held the supremacy of the air, and not until France and England built their aerial dreadnoughts did the odds again become even. As nearly as can be ascertained, *Fritz,* as this new machine was soon christened by the English, has a wing spread of between eighty and one hundred feet. In the central fusilage are mounted two heavy guns, and there are accommodations for two gunners and a pilot, with usually an observer to watch the enemy's lines. In two fusilages on the wings are two heavy motors, with the necessary room for mechanicians and engineers. The great power of the motors gives the battle-plane wonderful flexibility of speed.

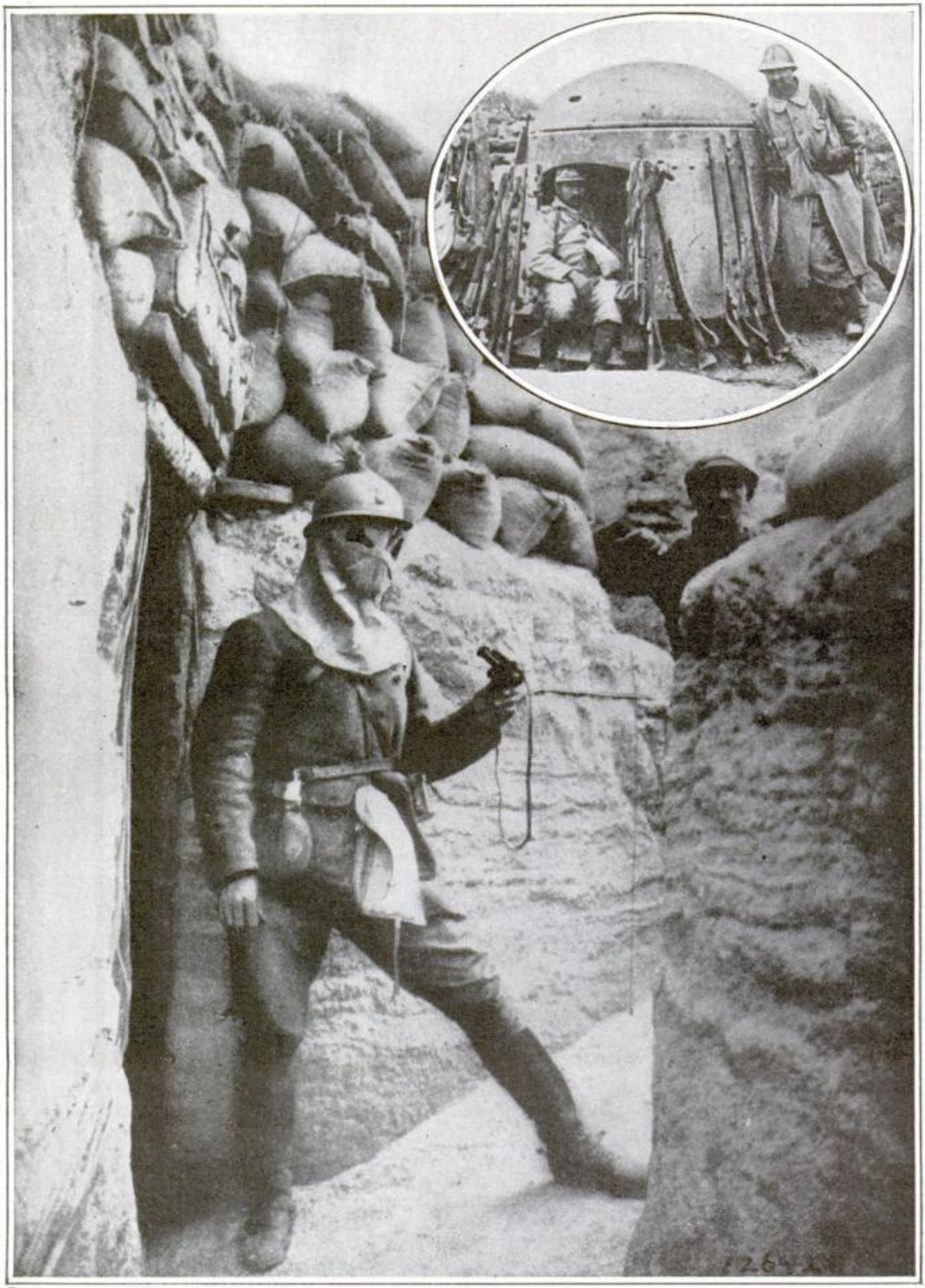


Scene in the Curtiss factory at Buffalo. Mechanics are seen working on one of the many aeroplanes of the "America" type, which are being turned out at this factory at the rate of one finished machine a day

Unsubstantiated reports from Europe credit the Germans with a new triplane which carries a crew of twenty men, eight motors, and five guns, including an anti-aircraft gun throwing high explosive shells of heavy caliber. This super-dreadnought is said to be sheathed with armor.

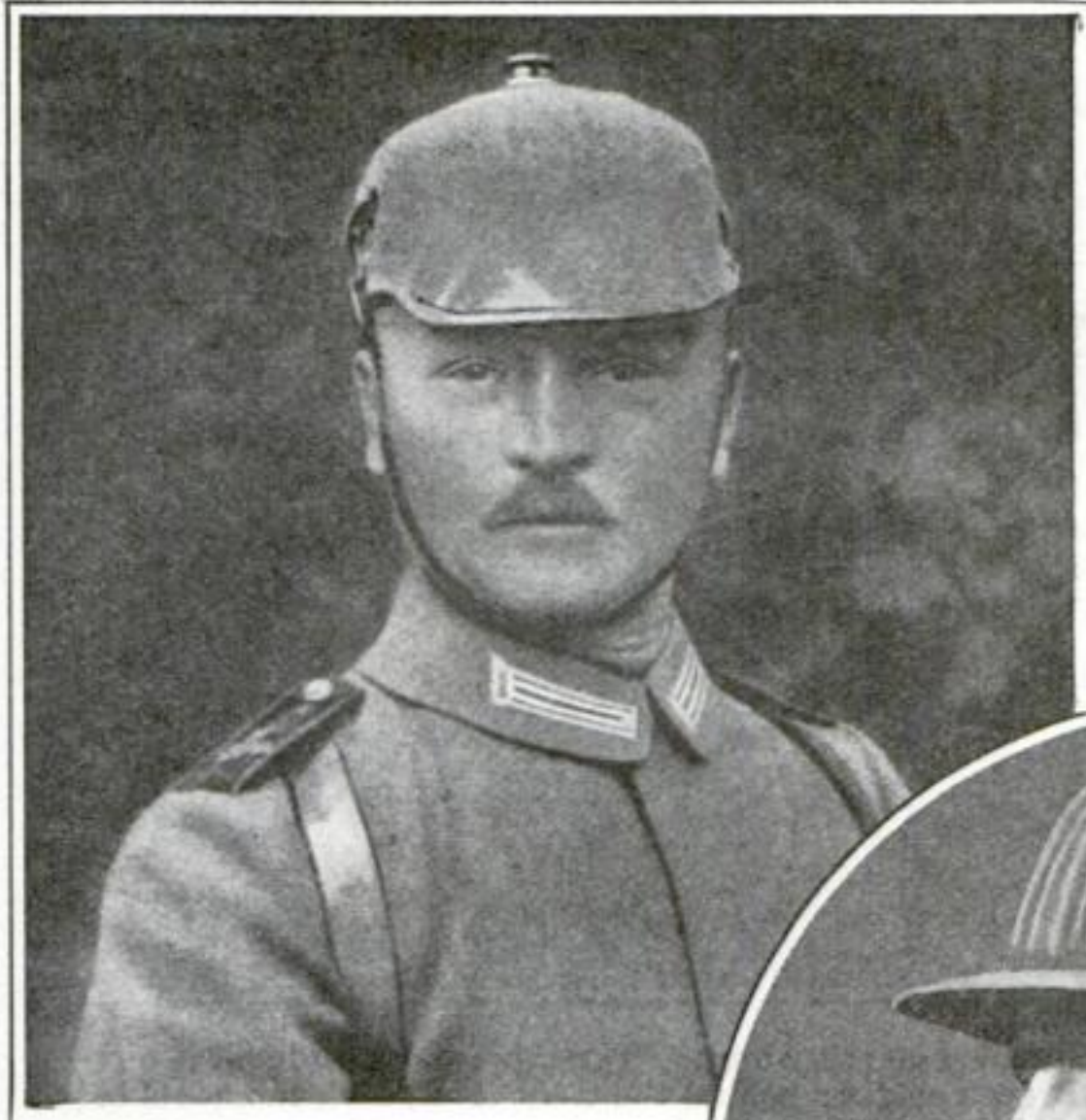
(*Continued in the April issue.*)

Exit the Black Charger—Enter the Gas Mask



The modern officer no longer dashes across bullet-swept fields on a snorting steed. In this war he gets orders by telephone and traverses the perilous gas-swept first-line trenches on foot. The hand-grenade at his belt is his surest weapon. In the oval is a naval turret captured in the German trenches in the Battles of Champagne.

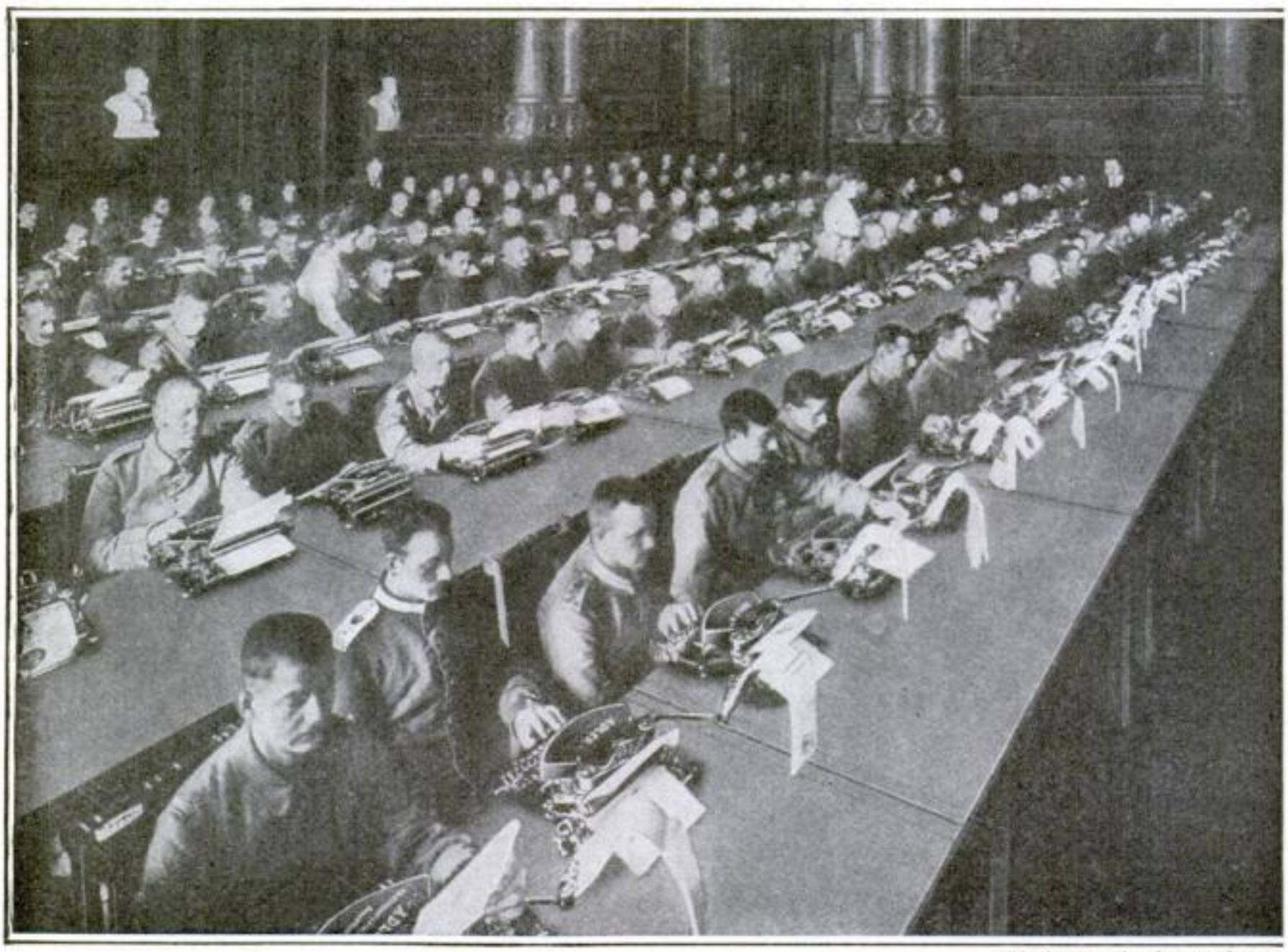
Protective Devices of War



The German spiked helmet of gleaming nickel was hidden, early in the war, with a gray cloth cover. Now the spike has disappeared, though the helmet itself is still of metal and still carries its cloth cover. The picture on the left shows the newest German officers' uniform, free from almost every distinguishing sign that would make the officers a special target for the enemies' sharpshooters

The British have adopted the steel helmet of construction similar to that of the French. It is now in general use and is shown to the right. Below are shown the new German uniforms for the Russian winter campaign, consisting of caps and overcoats of white slipped over the regular uniforms, making the wearers almost invisible against the snow over which they are now engaged in fighting

This dining table is not to be recommended on rainy days. The table and individual chairs have been cut out of the earth by French soldiers behind the trenches in their moments of relief from the strain of fighting. All's well so long as the sun shines



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Convalescent German soldiers who have been so seriously wounded that they will never be able to do heavy work, are being taught stenography and typing by government instructors. A large number of men are now employed in capacities requiring a knowledge of typing

Hobbling Prisoners with Their Own Trousers

The scissors are mightier than the rifle. Instead of placing a heavy guard around these German prisoners, the French officer merely cuts off the suspenders of the prisoners' trousers and cuts out a "V" from the belt, making a running escape impracticable

This picture continued from opposite page

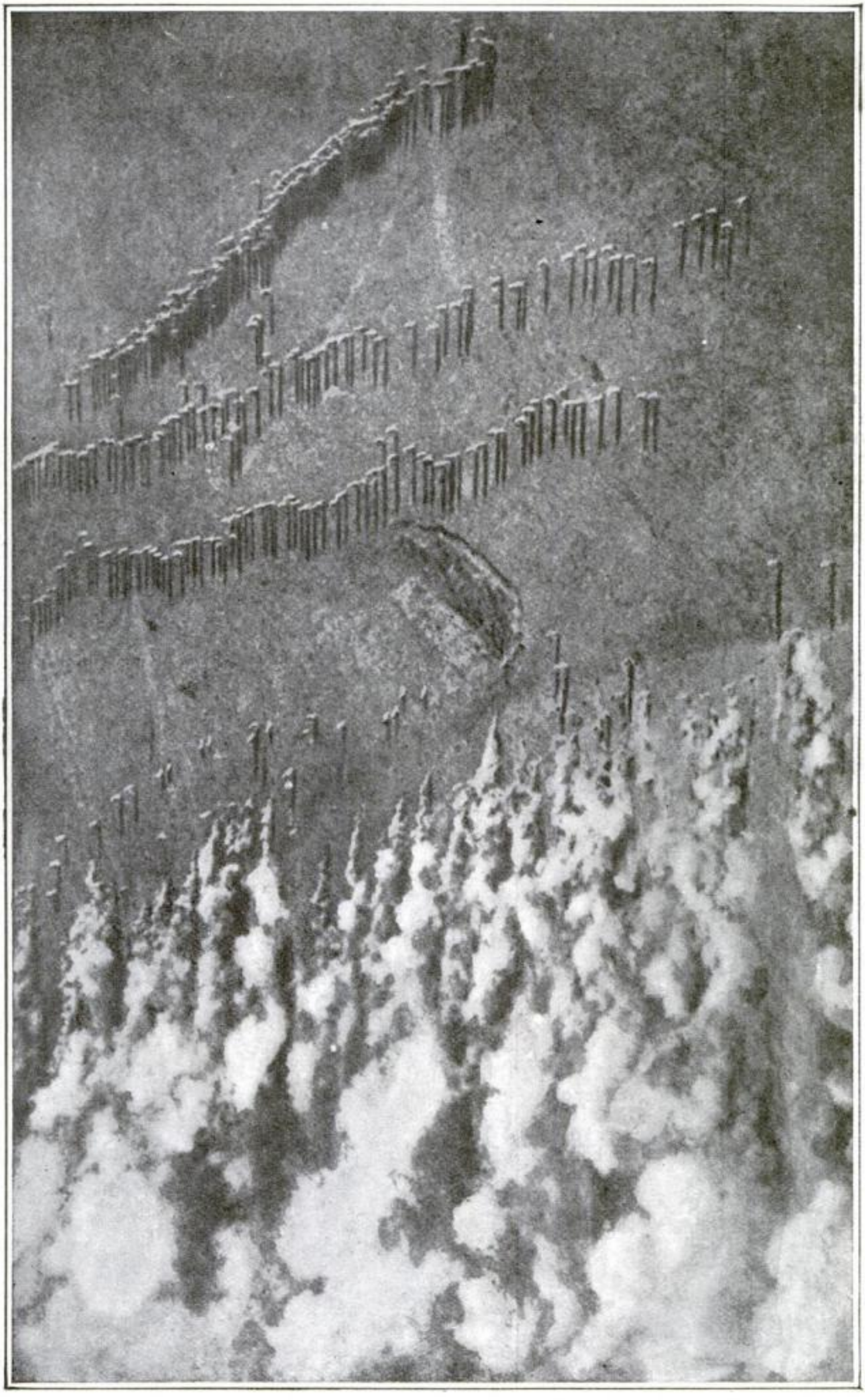
reduced by losses in the war, and by filling in their ranks with men who are fitted to do nothing else there will be an economic gain to the country as a whole. The illustration shows one of the classes practicing upon batteries of hundreds of typewriters

Women Who Do Men's Work in War

Women of the belligerent nations are doing men's work of a kind not usually allotted to them. Here we see them studying the trajectory of a projectile by means of a stream of water emitted from a vessel at various pressures

The standing figure is that of Fräulein Jarema Kuz, who volunteered with a regiment of Uhlans, and has served her colors so well that she has been promoted and decorated. The other two pictures show German women at work in the laboratories. These German women have added much to the strength of the German arms in the field. Much of the laboratory work connected with the war is now done by women

What the Gas Clouds Look Like



This extraordinary photograph was taken from a Russian aeroplane while the Germans were launching asphyxiating gas before an attack on Russian trenches. Behind these clouds, troops may be seen drawn up in three lines ready to charge

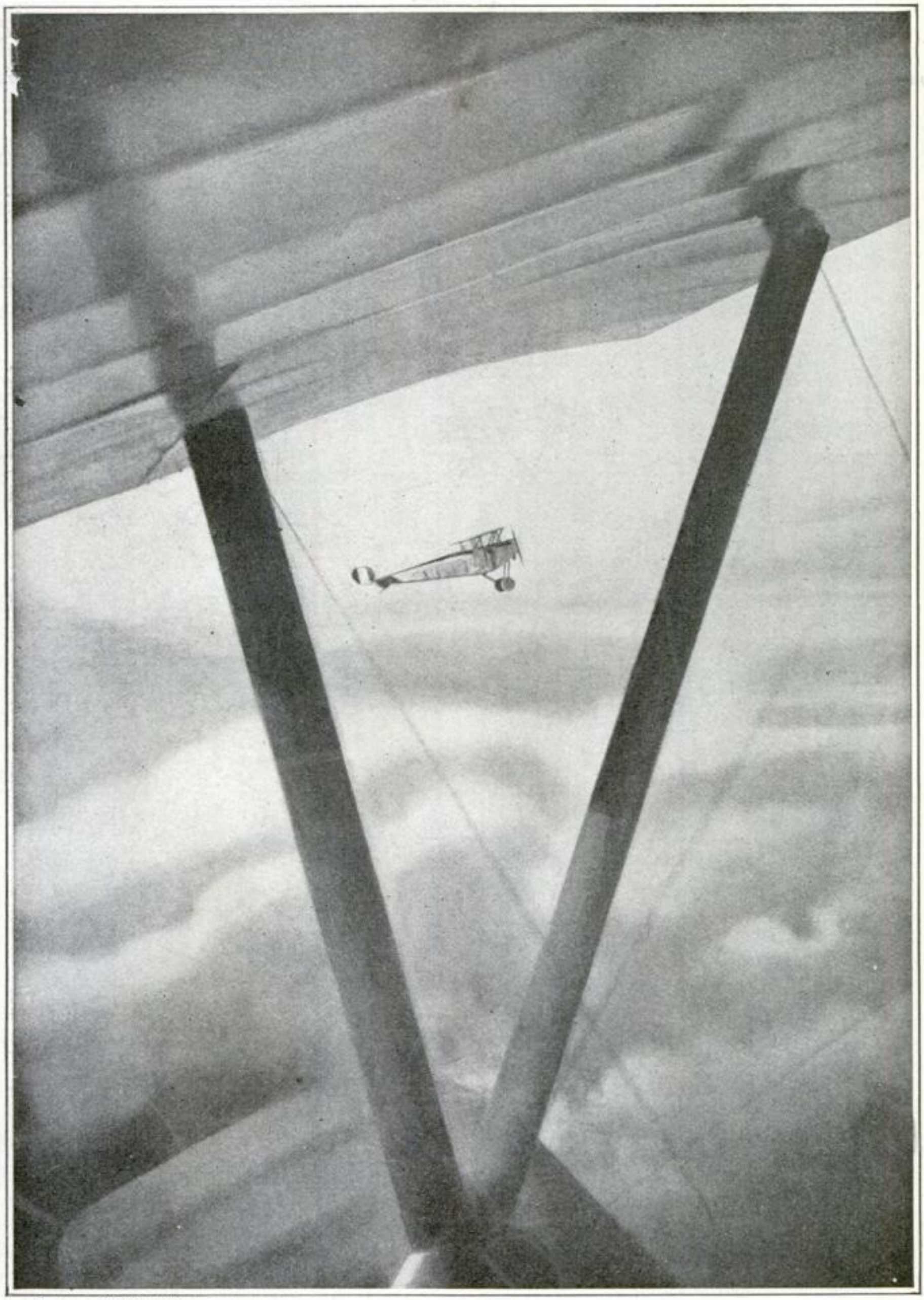
© International Film Service

Simplifying the Problem of the Hospitals

This new portable stretcher and hammock is being made for the Belgian Army. A sling is made for the folded bed to be hung from the shoulder

Safe from rain and wind the sleeper also has his gun ready in case of an alarm

A Sister of Charity astride her horse on the way to visit a trench



Courtesy of L'Illustration

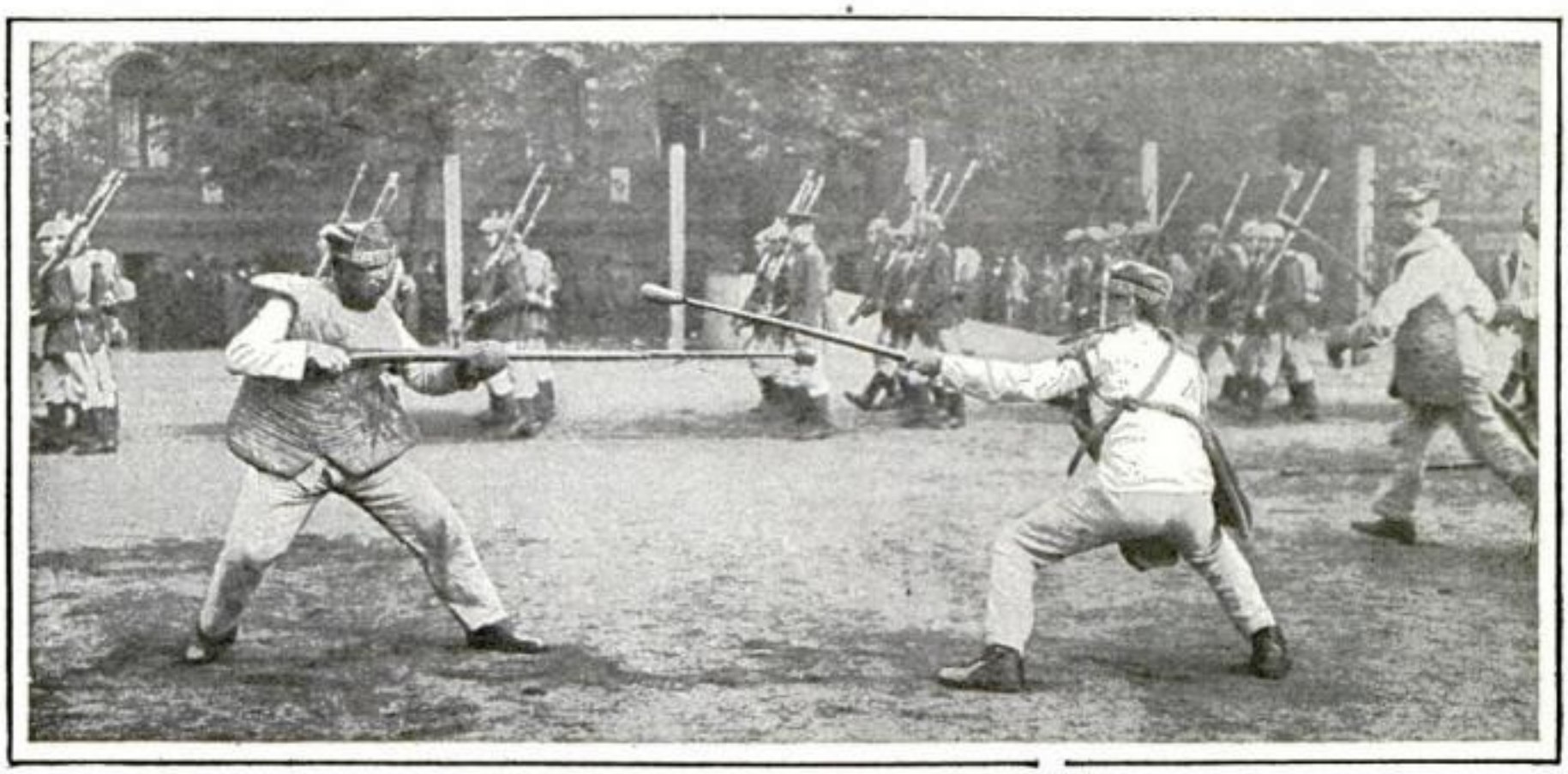
Companion aeroplanes above the clouds. This remarkable, official photograph was taken from a French aeroplane just as a comrade's machine flew past. The sea of clouds over which the aeroplanes are flying may be clearly observed in the illustration

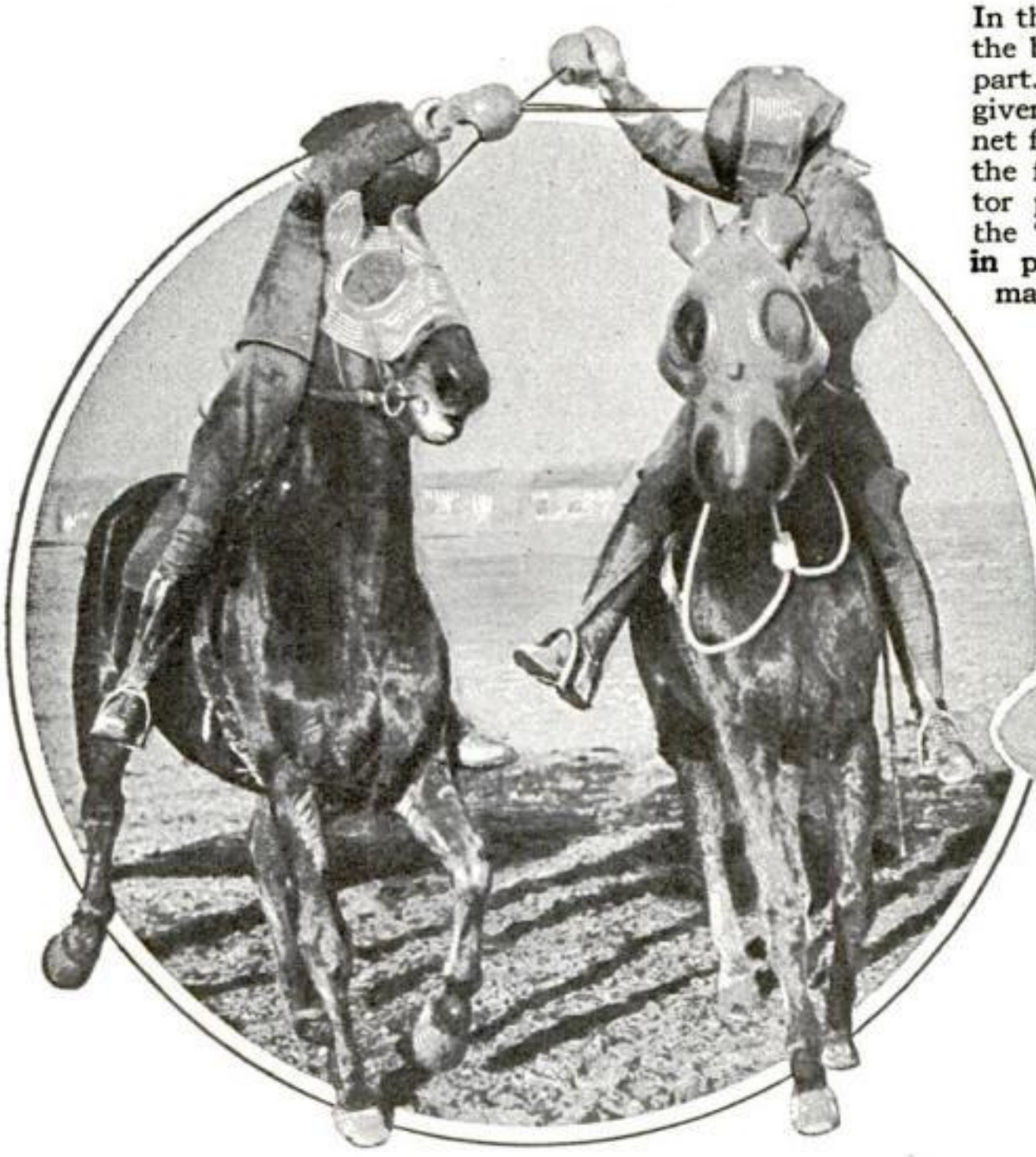
Cave-Men of the Trenches

On the right bank of the river Oise, near Noyon, France, there are several caves and chasms so extensive that they can give shelter to a whole regiment of troops. The great arch shown in the photograph to the left has been named by the Germans "Bismarck Rock." Soldiers are shown building a scaffolding in order to place an appropriate inscription over the entrance

An officer's underground home in "The Forest of the Saxons," so called because a regiment of German Saxons are quartered there. Much time and care have apparently been spent in the construction of this bomb-proof, as it is complete to the smallest detail. Below, a realistic picture of the "home life" of the French soldiers in an underground grotto

Preparing for the Crises of Battle

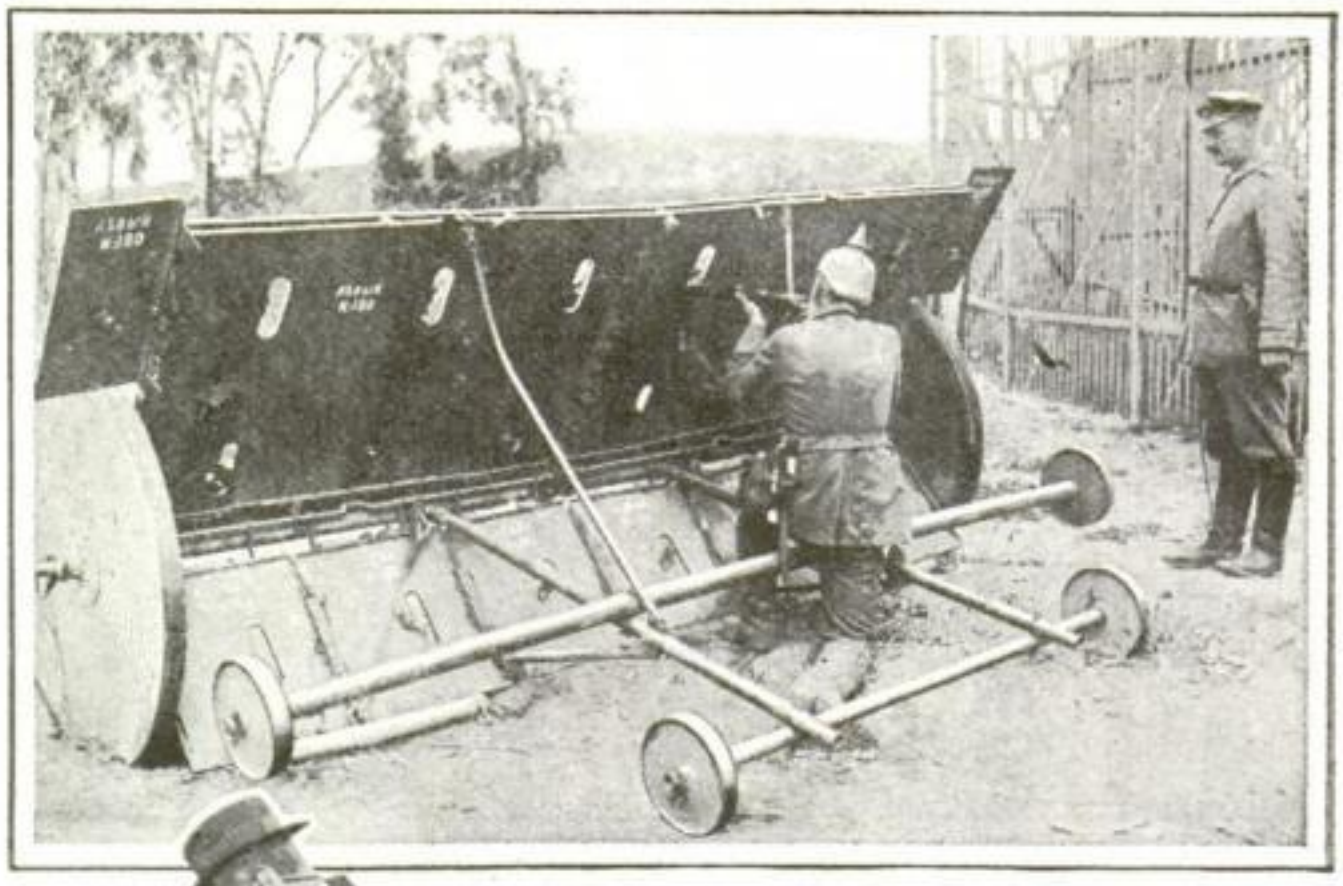




In these days of trench fighting, the bayonet plays an important part. Recruits in all armies are given a thorough course in bayonet fighting before being sent to the front. Below, a French aviator profits by the example of the "tramp" and wraps himself in paper. This novel suit is made of a special paper, and is intended to be worn beneath the uniform

While awaiting their orders to start for the front, Canadian cavalrymen spend many hours practicing with the sword. Horses and men are well padded, and special swords are used to prevent injury

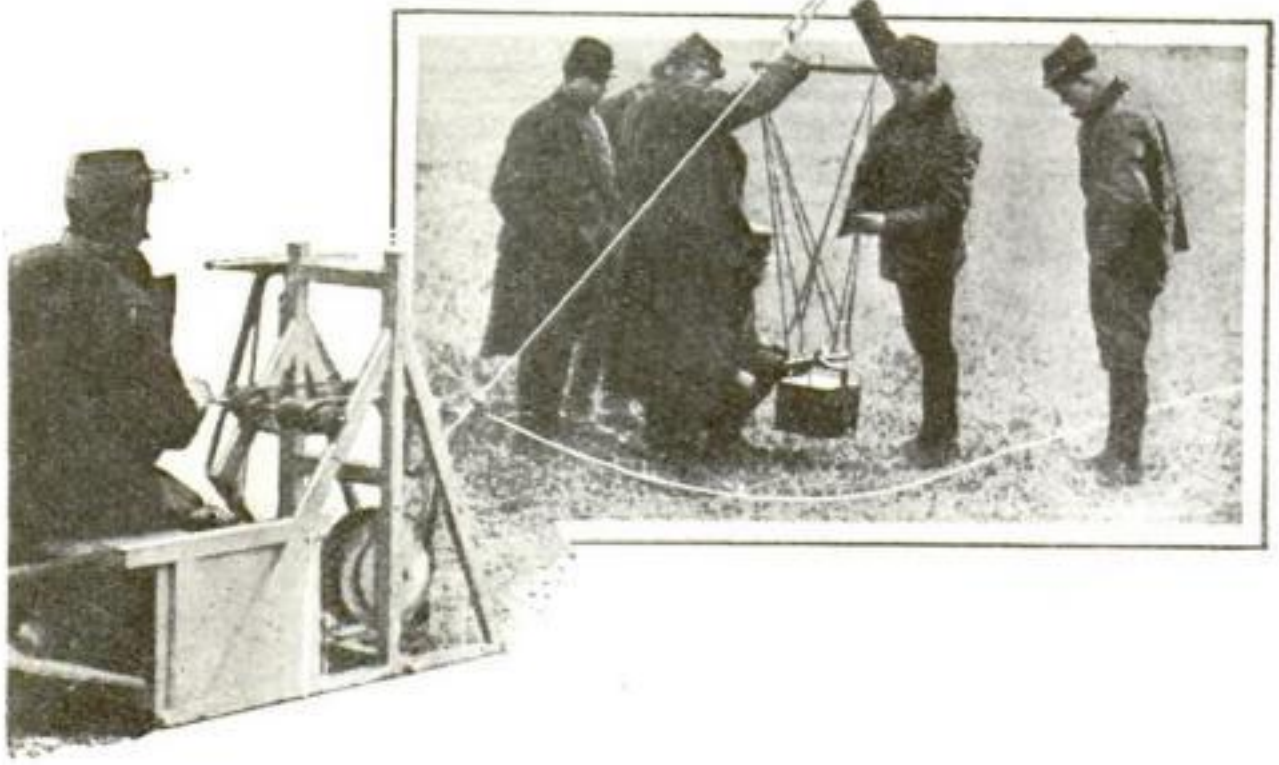
Inventions the War Has Brought Out



A Russian portable shield captured during a retreat and now used by the Germans. This shield is made of bullet-proof steel and is admirably designed to shelter five riflemen who protect their trench-digging comrades. The shelter may be taken to pieces in a very short time and packed for transportation in motor trucks

Listening to the sound of heavy guns with the aid of a tin-can telephone receiver. A tin can, suspended from a copper wire which is wound about a pencil or penholder pressed against the bone back of the ear, makes an excellent instrument for detecting these sounds when they cannot be heard otherwise

An ingenious French device for photographing the German positions. A special camera is attached to a kite, and when the proper altitude is reached, the photographs are taken automatically. Occasionally the kite is sent up from an automobile, and is towed to the desired locations. One of the interesting phases of the war has been the use of kites, even man-carrying kites, in war observations. A camera can well take the place of the man, especially in a kite. The distance from the ground can be accurately estimated by means of a theodolite, the instrument used by surveyors

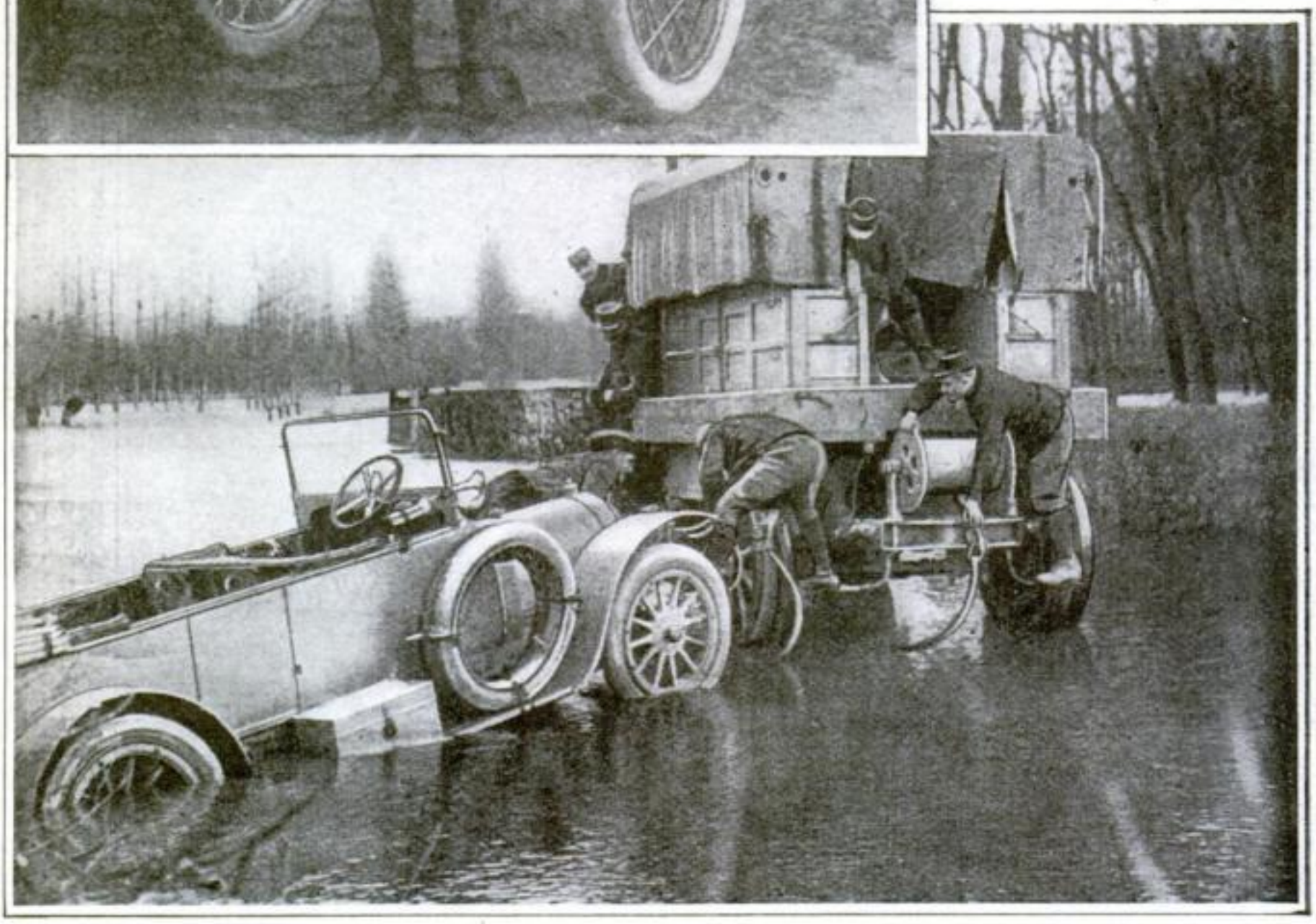


Archeologists of the future will find the ruins of the European war zone almost as full of horror and interest as those of Pompeii and Herculaneum. **No disasters of ancient history are more tragic. It is likely that many such little towns as Iretelsburg, pictured here, will never be rebuilt on their old foundations, but that new sites will be chosen in the farming country near by. The cost of removing such ruins as these is prohibitive where land is cheap and the destruction so complete**

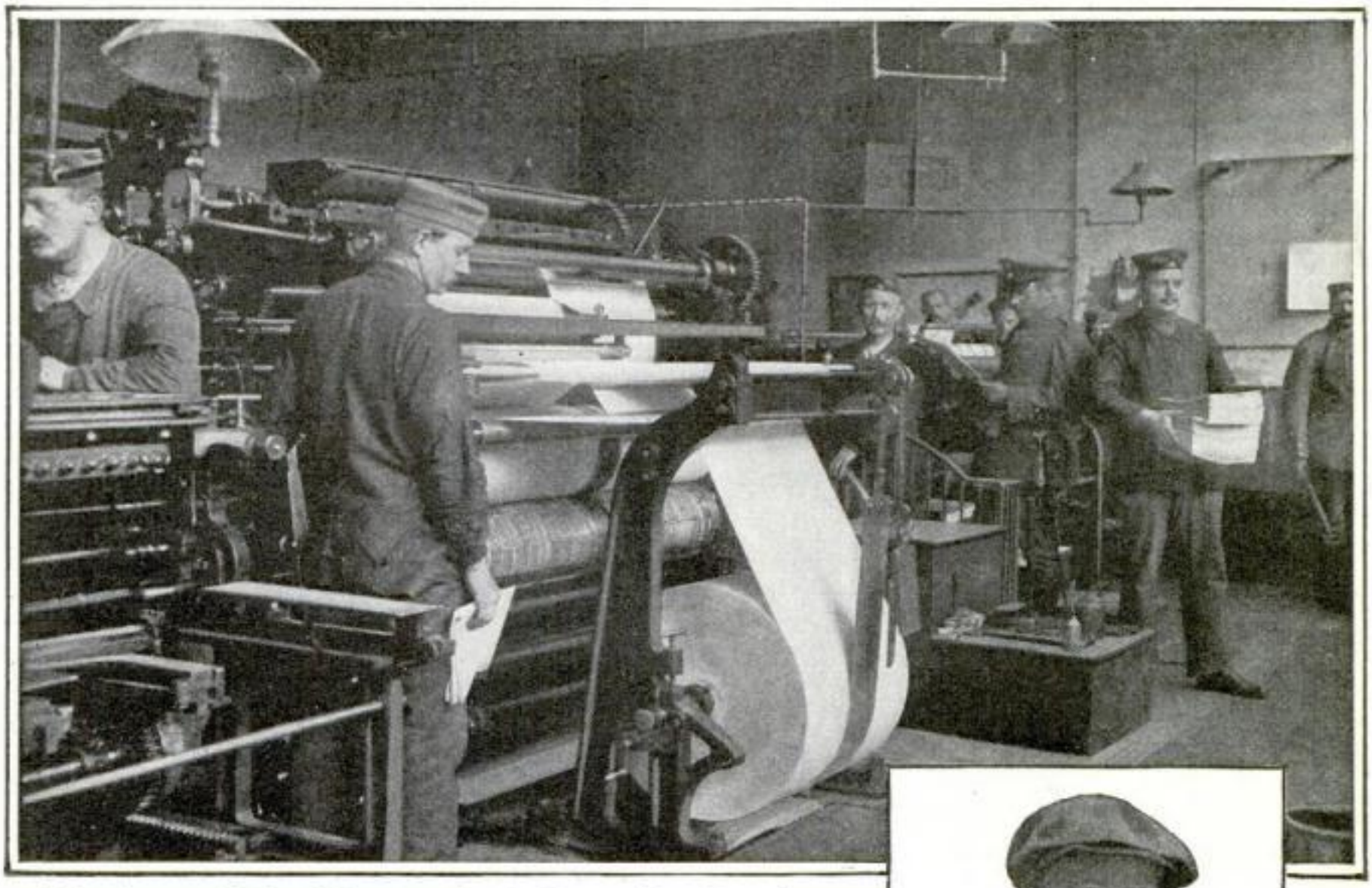
Two Phases of War Transportation

One of the new French battle 'planes, equipped with a three-inch rapid-fire gun. Owing to the substantial construction of modern aeroplanes, it has been found that a spray of bullets from a machine-gun or a shrapnel shell does little damage, unless one of the bullets strikes a control wire or seriously wounds the pilot. The latest development is the installation of guns which throw explosive shells. These shells, if correctly aimed, will tear the framework of an opposing aeroplane to pieces

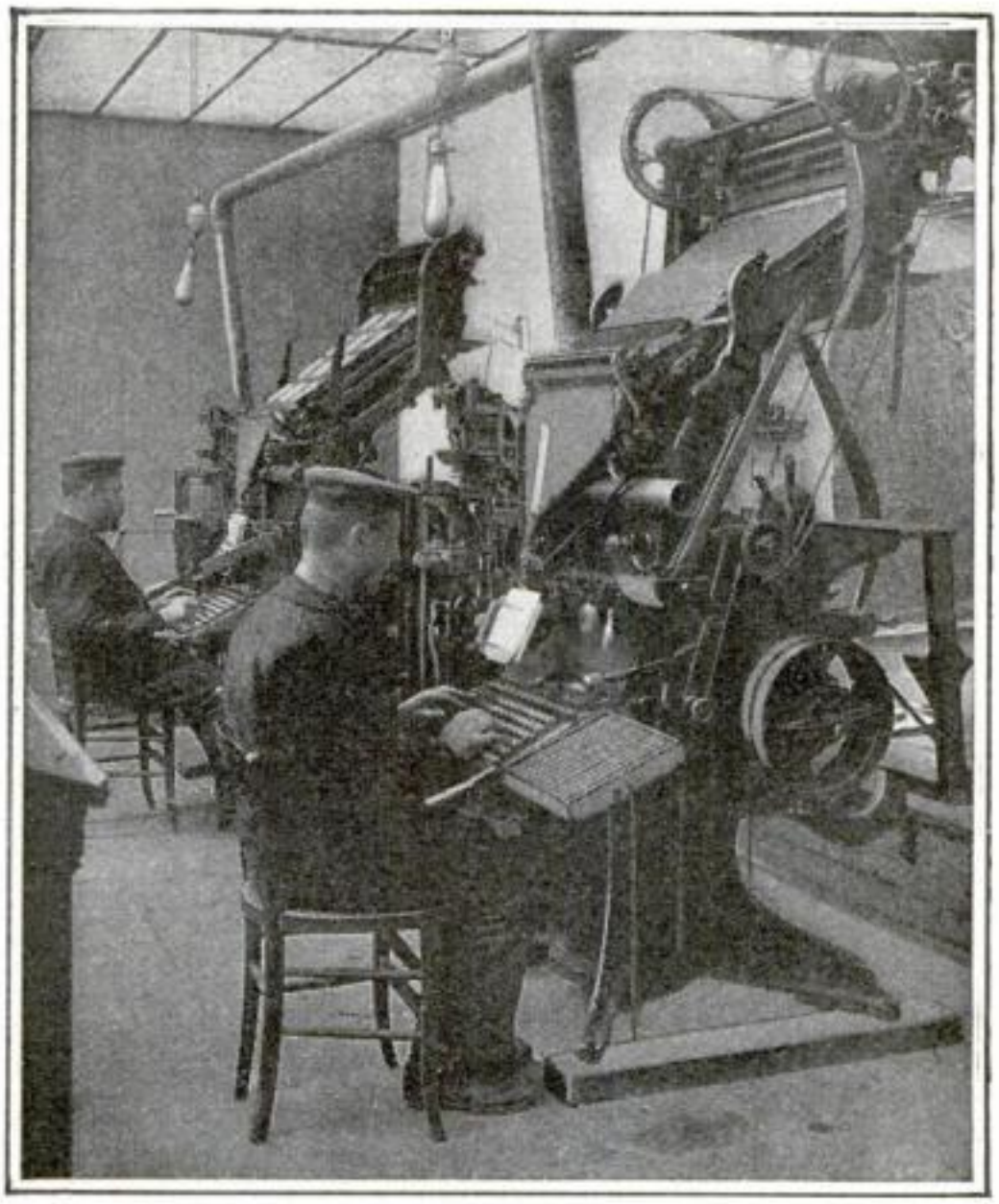
Below is pictured an incident by no means uncommon in military service. A French staff car has become mired in the bed of a flooded stream. Repair cars are within easy calling distance in almost any district in the war zone, and the mechanics are equipped to handle any kind of an accident, from that shown; to the removal of a car which has been hit by a high-explosive shell



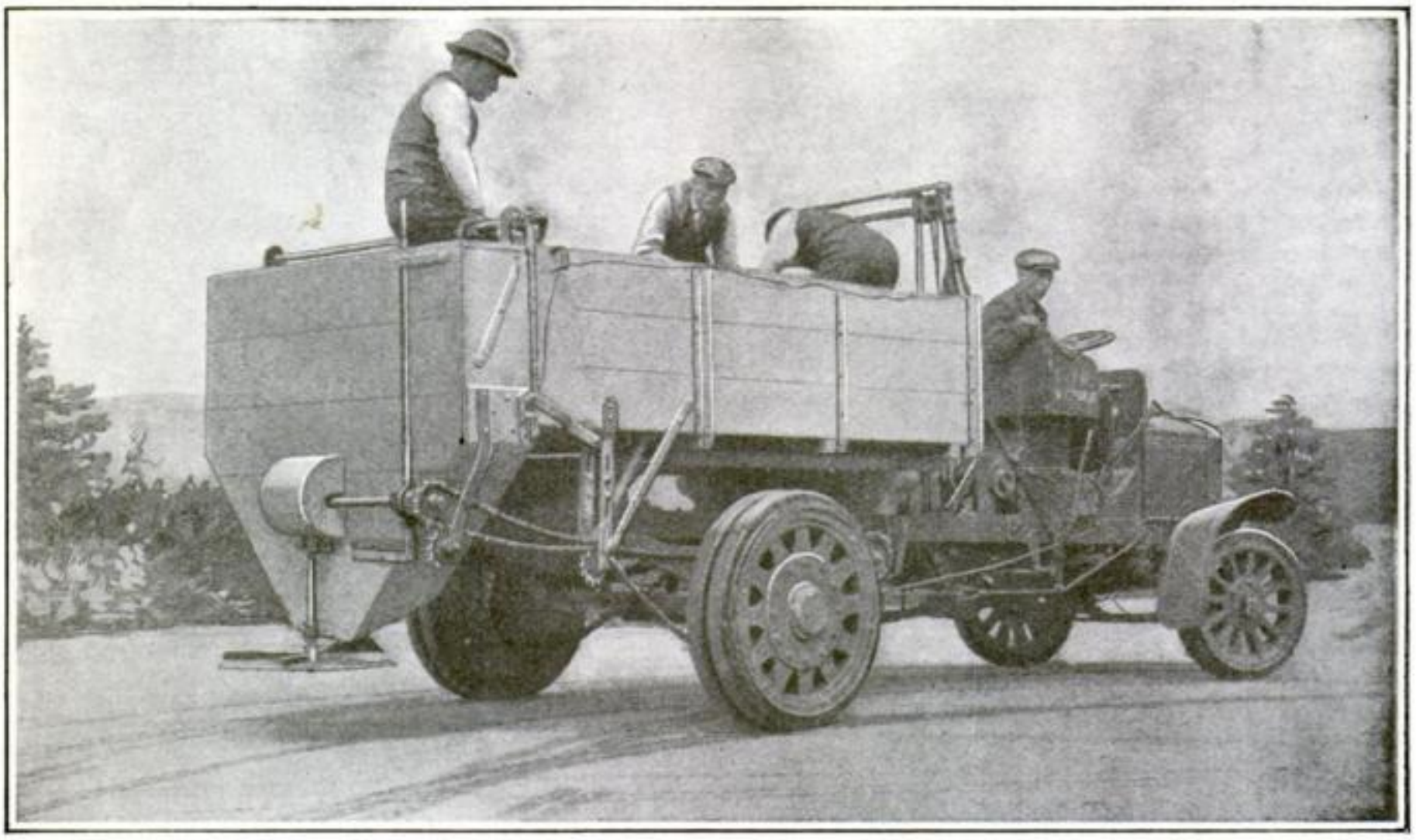
Printing a Newspaper Is Part of the War Game



The home of the "Gazette des Ardennes," a French newspaper published by the German Army in the captured French town of Charleville. The paper is chiefly intended for the inhabitants of the territory occupied at the present time by German troops. The first issue appeared in November, 1914



The first anniversary number was, like its predecessors, printed in French and sold by little French boys



Revolving fan blades beneath the hopper of this sand truck throw the sand over many feet of street surface which has been freshly oiled

Spreading Sand over Oiled Roads by a Motor Truck Attachment

IT is the custom in some cities to sprinkle sand over freshly-oiled streets to prevent oil from adhering to vehicle wheels or from being tracked upon sidewalks by pedestrians.

To accomplish this work more rapidly, Mr. Charles H. Rust, City Engineer of Victoria, B. C., attaches a wooden hopper to the back of a motor truck. At the bottom of the hopper is placed a small door to allow sand to run out of the hopper at any desired rate. Just below this door is a revolving disk with wrought iron vanes or ridges riveted to its upper surface. The disk is driven through bevel gears and a chain and sprockets from the rear axle of the truck.

Shovelers within the body of the truck keep the hopper filled with sand, and as it runs out upon the whirling disk, the vanes throw it out over a space ten feet wide.

The disk is thirty inches in diameter and revolves at a rate of two hundred and eighty-five revolutions a minute. The truck travels at a speed of three miles per hour.

Nine Thousand German Aeroplanes

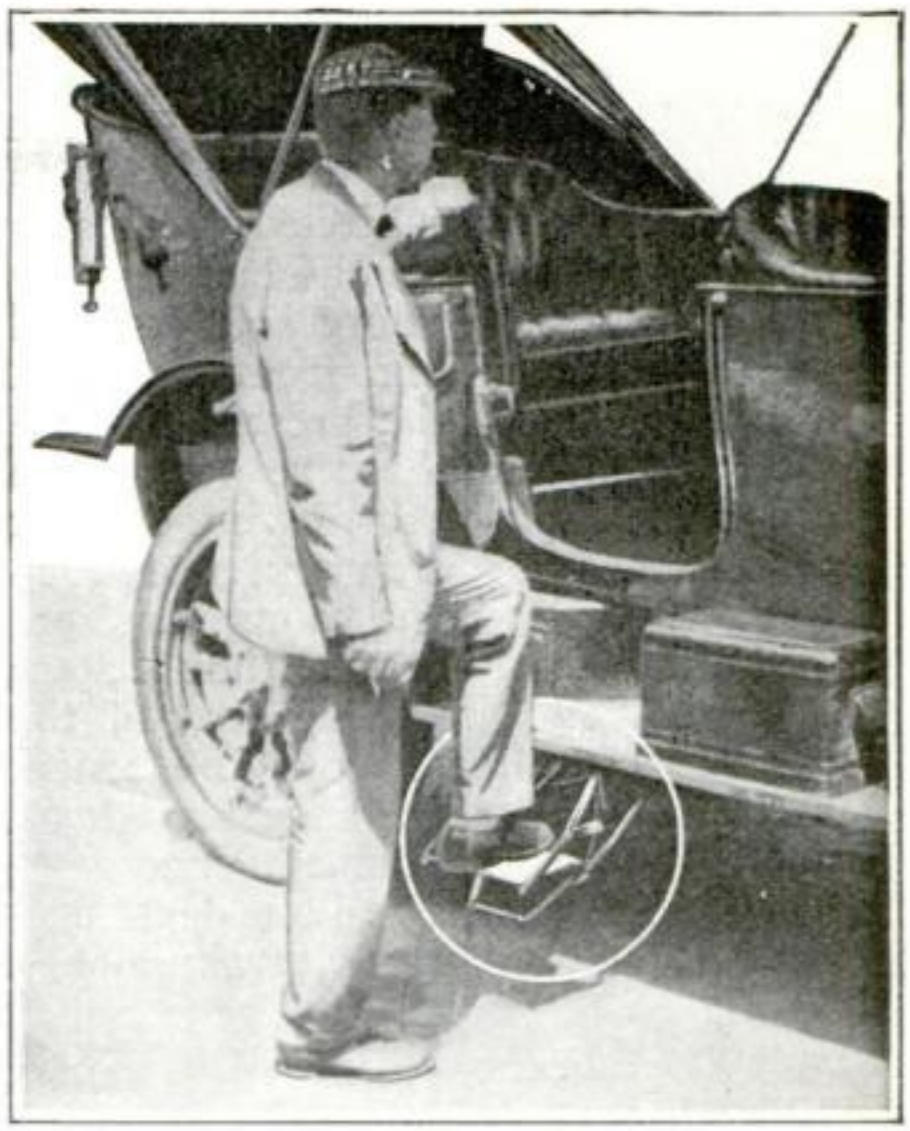
ONE of the most closely guarded secrets in the military establishments of Europe at the present time is the strength of the flying corps. That Germany at present has at least nine thousand war aeroplanes in active use, is the statement attributed to one of the higher officers last month. This officer, when the military attache of one of the South American nations commented on the plans of the British government to build ten thousand aeroplanes, remarked casually, "We have more than nine thousand ourselves!" In this connection it is also reported that along the Russian front, only an exceedingly thin line of infantry holds the trenches, and that nearly two thousand aeroplanes are cruising above the battle lines in the East, notifying the German headquarters in ample time of any movements along the Russian front. The crying need of the Russian armies now is flying machines, of which they need at least two thousand to be able to cover their own movements of troops. The greater the number of machines an army possesses, the fewer are lost. Hence the demand for a large corps.

A Convenient Step for Automobiles

THE running board of an automobile is not an easy step for many people, especially women and children. To make the boarding of the car easier a folding step has been put upon the market by an Indiana inventor.

The step is mounted under the running board and is operated by compressed air. The driver of the car simply presses upon a pedal when the step is required, and it lowers itself. When folded into place it is entirely out of sight and is so constructed that there is no rattling. It adds but small weight to the car.

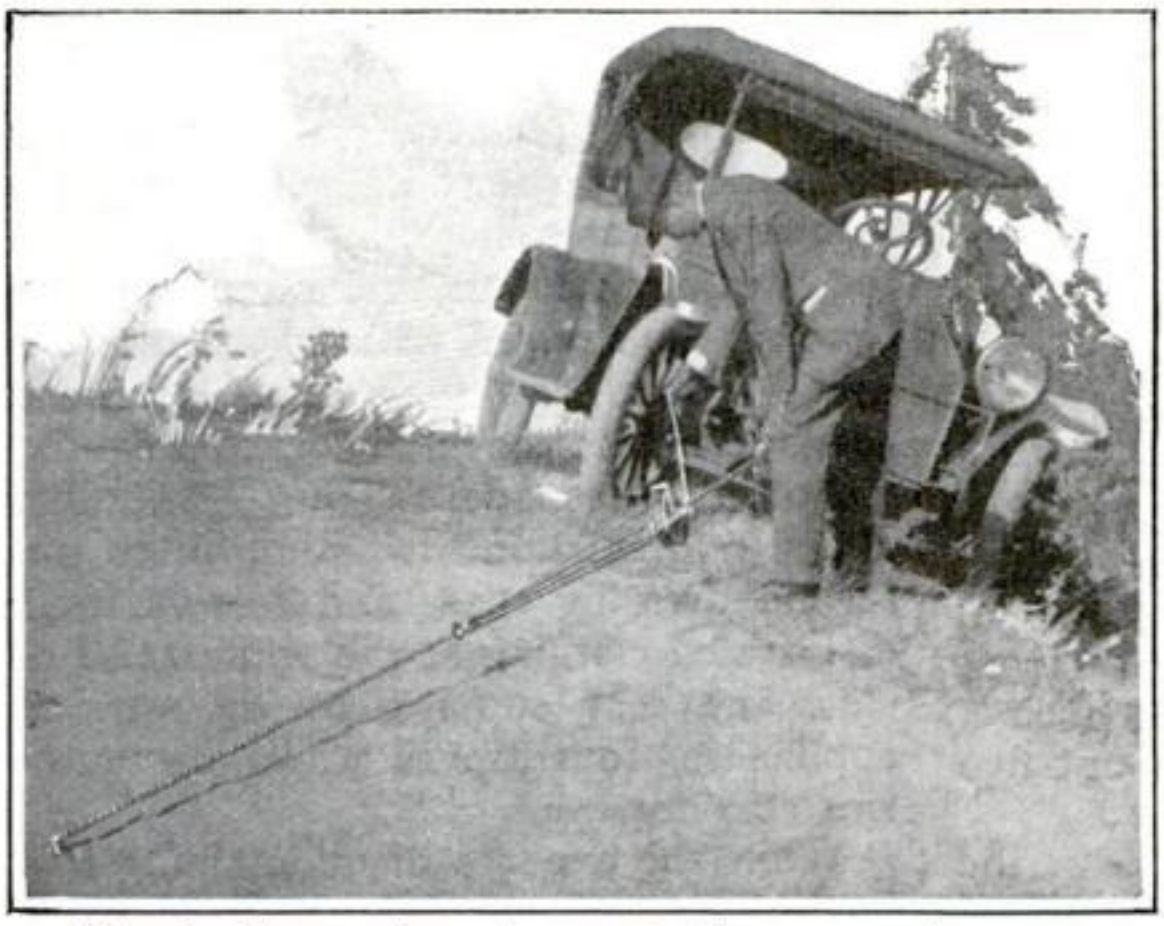
A similar step has also been perfected by the inventor for railway trains. When opening the vestibule door of a car at a station, the porter simply pulls a lever and the step drops into place. This saves the handling of the wooden step usually carried on Pullman cars.



An automatic step lowered by pressure on a pedal. By its aid a small child may board the car with no great difficulty

Pull Yourself out of the Mud

THAT perpetual horror to the motorist of sliding down a bank into a ditch at such an angle that he cannot get out under his own power is banished to a fairly comfortable distance by a compact block and tackle arrangement so easily operated that it can be used without danger of soiling the clothes. The apparatus consists of a hand crank, pulleys, steel cable and chain. One of the chains is fastened to the three stakes driven in the ground. The other chain is attached to the framework of the automobile. The pulleys and wire cable are in the middle. Turning the crank exerts a leverage of great power—actually seventy times as great as the force applied—so that little difficulty is experienced in dragging even a large motor out of a deep rut or ditch back into the roadway.



Turning the crank exerts seventy times as much power as the force applied, so that the car is easily dragged out of the ditch or up an embankment

An Owl Darkens the Town

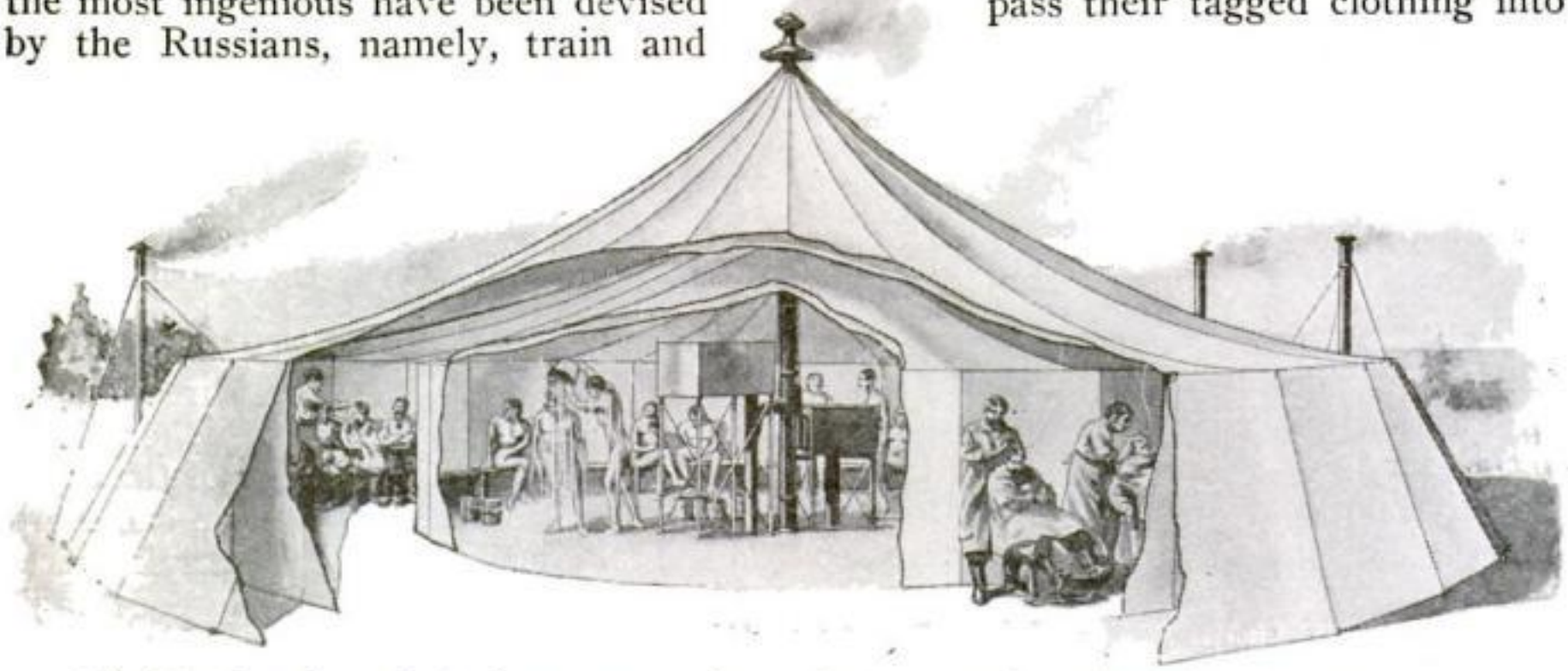
ON a recent evening a large horned owl plunged the town of Van Buren, Ark., into darkness when it alighted upon a steel tower and caused a short circuit of the main feed wire which supplied the town with electricity. The bird, which measured five feet across the wings, was killed by a current strong enough to kill a horse. The lighting company secured the body of the dead bird, and put it on exhibition.

Train and Tent Baths in Use by the Russian Army

FILTH, vermin and disease are among the most deadly foes to which an army is subjected. This is proved by the wars of the last century in all of which far more soldiers died from epidemics than from wounds. The combatants of the present day are more fortunate in these respects than those of the past, for owing to the great advance in sanitary science much better hygienic regulations are enforced. Many problems, though, are not yet solved, one being that of the personal cleanliness of the men. Among the various methods brought forward to meet this difficulty two of the most ingenious have been devised by the Russians, namely, train and tent baths. The bath train consists of a series of cars, one for dressing, one for disinfecting the clothing with formalin at a temperature of two hundred and twelve degrees, another for the baths, still another for putting on clean underwear and the disinfected uniforms, and a final one for rest and refreshment. The equipment of such a train costs about twenty-five thousand dollars to thirty-five thousand dollars and baths can be given to from two thousand to three thousand men a day at a monthly expense of about five thousand dollars.

The tent has the advantage over the train that it can be set up at the actual front. It can be raised and struck easily, the equipment can be separated into parts not weighing over six hundred pounds, which can be transported on two-wheeled carts; the interior is protected from cold, and one hundred men per hour can bathe, have their hair cut and their clothes disinfected. There are two concentric tents supported by the same center-pole. The inner tent forms the steam-chamber, where fifty men at a time can have a steam bath. The circular corridor between the two tents is divided into five compartments, two dressing rooms, a mechanical hair-cutting section, a laundry for towels, etc., and a disinfecting chamber with four disinfecting appliances. The men enter the first dressing room, pass their tagged clothing into the disinfecting chamber and enter the hair-cutting section where one man's hair is cut per minute, and then go into the steam chamber. The temperature here is one hundred and twenty to one hundred and fifty degrees; there are hot and cold water cocks, pails for the men to use, and benches—not tubs. After half an hour the men enter the second dressing room and receive their disinfected clothing at the window. Besides the heat supplied by the various appliances, four stoves warm the exterior corridor.

While the expense of maintaining this institution may seem high, it is more than offset by the advantages derived in the way of sanitation.



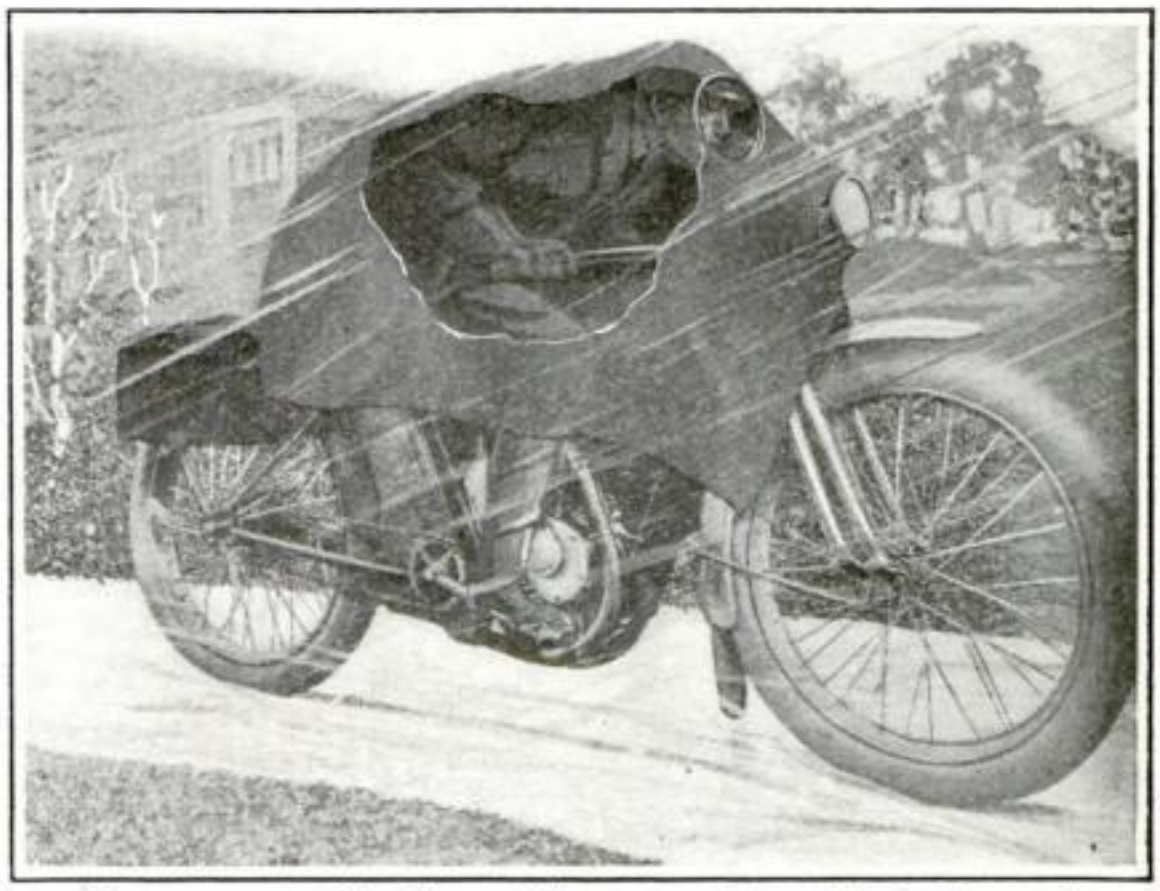
The Russians have devised as many sanitary short cuts and mechanical engines of war as any of the battling nations. Here is a picture of one of the big tents which help to make cleanliness possible to soldiers who come from the muddy trenches

A Cold or Wet Weather Suggestion for Motorcyclists

A SIMPLE yet convenient hood or cover for a motorcycle can easily be made from a piece of heavy brown canvas (brown for looks only) or a piece of rubber cloth about 36″ by 48″.

The canvas should be cut into the shape shown in the picture, then hemmed to prevent raveling. The hood may be securely tied to the handle-bars with pieces of rawhide; but care should be taken to place them far enough forward to allow free movement of the grips. In the same manner as above rawhide strips are run through to tie the hood firmly under the head light. Likewise, in the rear, pieces of rawhide or soft iron wire are fastened to the mud guard braces to hold the hood in place.

The hood is now finished, and the illustration shows how it looks on the machine.



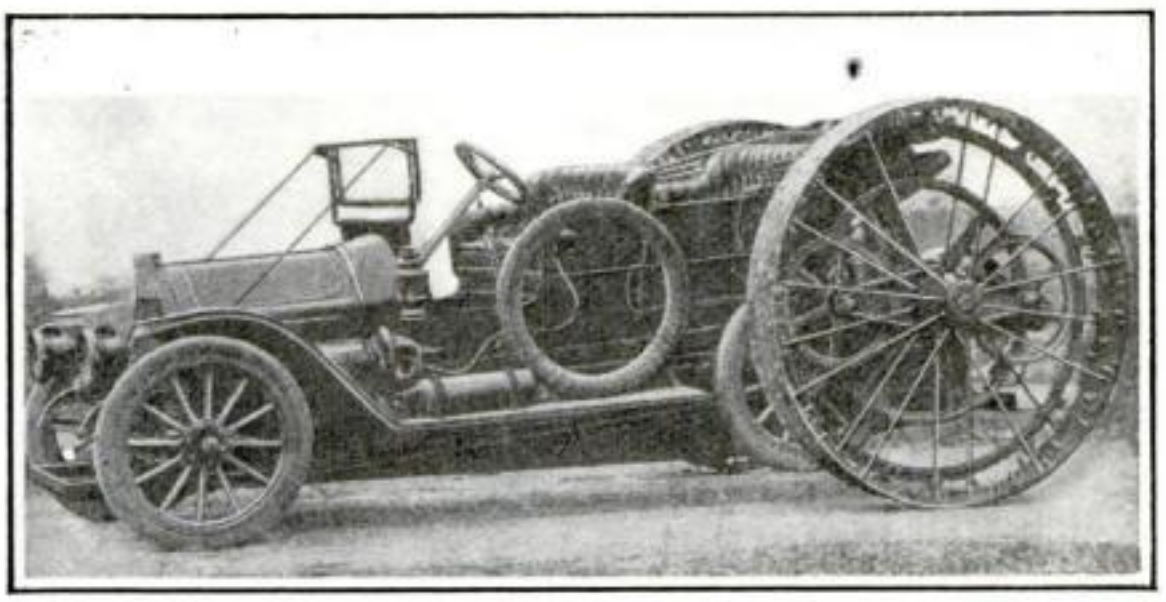
The motorcyclist is usually exposed to wind, rain and sleet. An ingenious cyclist has devised this covering to protect himself

Automobile and Tractor, Too

TO design a farm-tractor is not difficult, as is evidenced by the thousands of such machines in use in the western states. Nor is it difficult to design a pleasure vehicle. But to combine a touring car and a farm-tractor suggests problems that do not appear easy of solution. Yet the designer of the curious-looking vehicle shown herewith has experienced no particular difficulty in successfully combining these two types of widely differing vehicles.

The basis of the vehicle, as may be seen by the picture, is an ordinary five-passenger touring car, complete even to its top, its windshield, and its spare tire. It is converted into a farm-tractor by the simple expedient of jacking up the rear wheels and attaching the great tractor-wheels. These wheels are driven by spur-gearing attached at the ends of the driving axles of the touring car.

To adapt the tractor to different kinds of work it has gearing which permits two speeds, the high gear giving four miles an hour and the low gear two miles an hour. In addition to its usefulness as a tractor, the vehicle can also be used for power purposes about the farm, there being a power shaft, not shown in the illustration. At the rear is an extra radiator to prevent overheating when plowing at slow speed. In action, the tractor will drag three sixteen-inch plows through soft or wet ground, and will accomplish the work of four to eight horses.



The rear wheels are jacked up and the tractor-wheels are attached. Thus an automobile is changed into a tractor when it is not wanted for touring, and the machine is used at least twelve hours a day

A Civilized Man's Totem Tree

GEORGE E. CARR, a Civil War veteran of Union Springs, N. Y., has carved a totem tree that is "different," as he says, from the totem which

This white man has no use for coats of arms, but he has expressed his personality in a carved totem pole of his own making

the Indians regard as a family tree. He made it after his own fancy, spending two summers in decorating it with animals, birds, portraits, and curious figures.

At the top he placed neat little bird houses. To heighten the artistic effect, he painted the objects a variety of colors. The tree is eighteen feet high and six feet in circumference, and has thirty-four figures carved on it. These figures are part of the tree, not carved and placed on it.

THE commission form of government is in effect in eighty-one of the two hundred and four cities in this country that have a population of over thirty thousand.

Huge Twin Lanterns Light Entrance to School

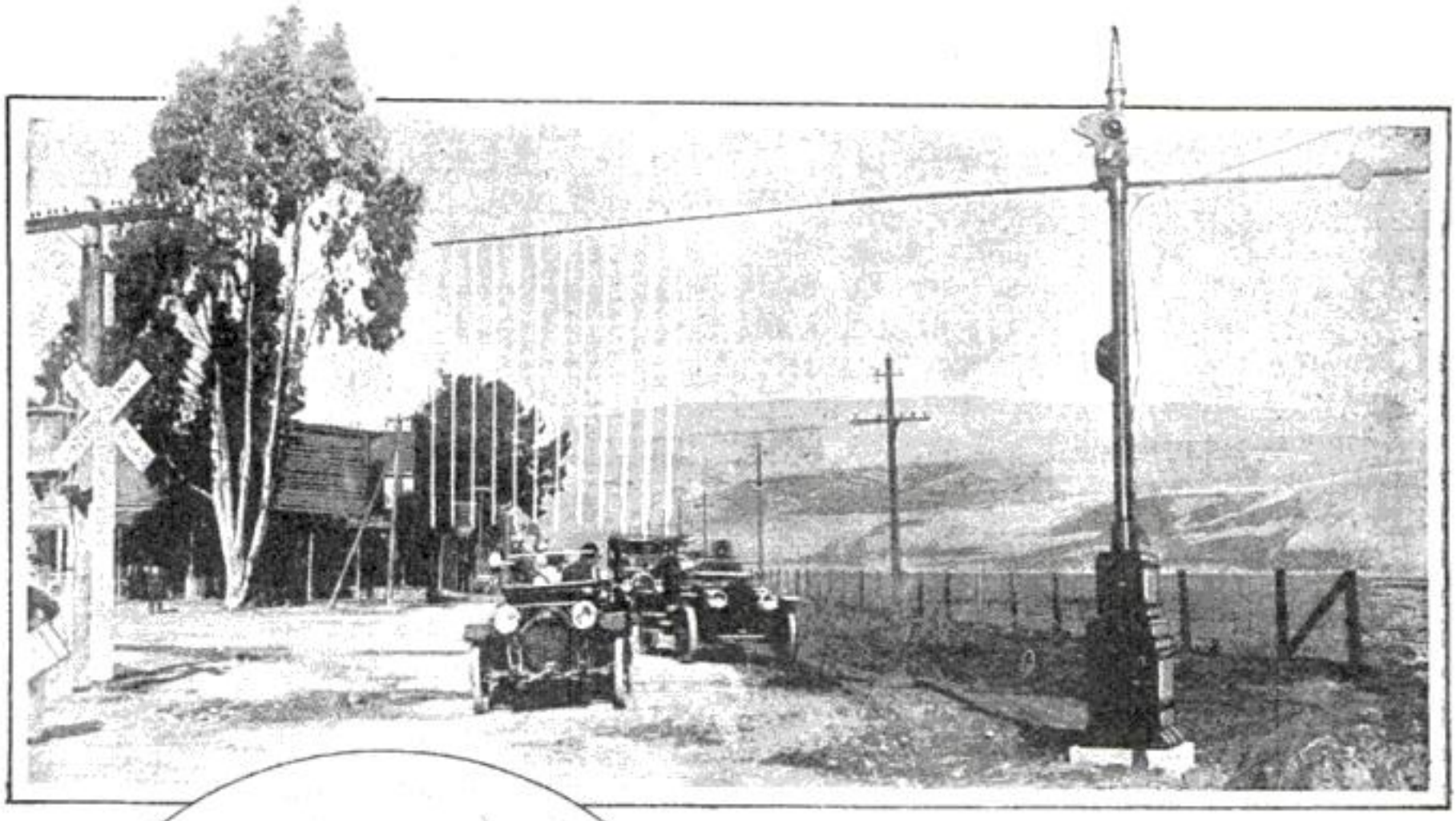
THE lantern shown is one of two which are to be used in lighting the entrance of the new Pullman Memorial Training School in Chicago.

The lantern is eight feet in height, the diameter of the cap is four feet, and the panels are three feet high and twelve inches wide at the top, tapering to nine inches at the bottom. The material is cast bronze; each lantern weighs six hundred pounds.

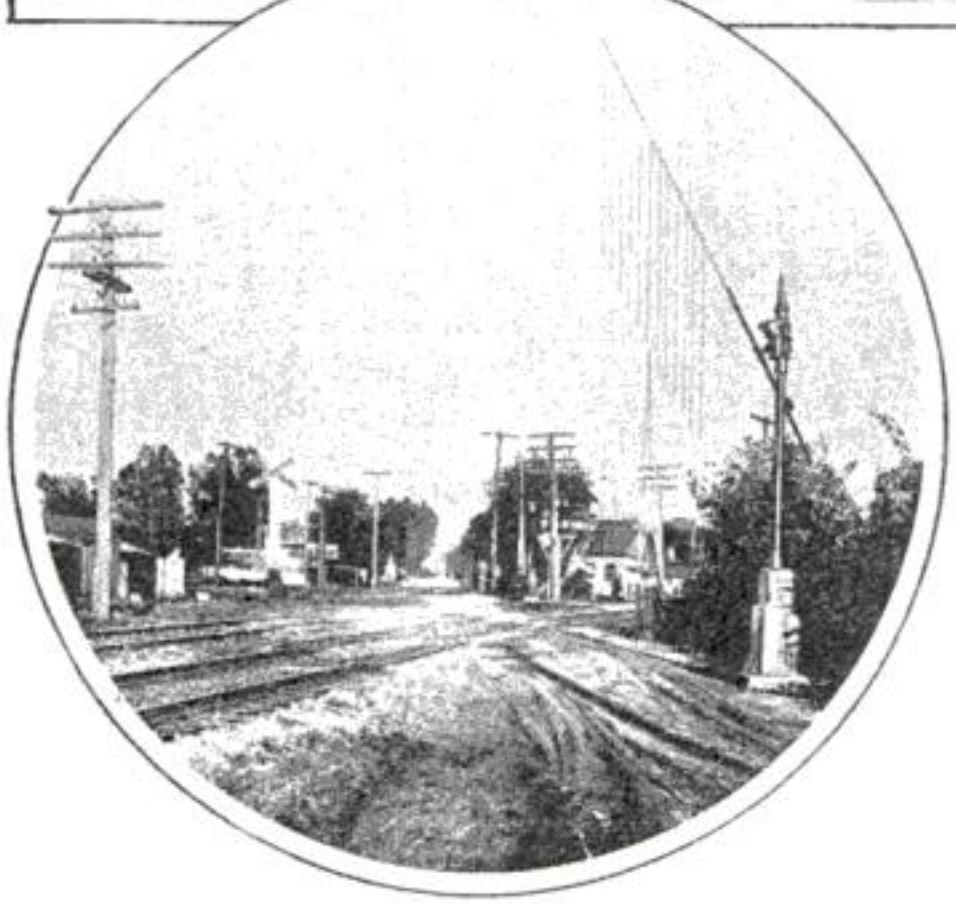
A one thousand watt lamp is set in the base of each lamp in a specially constructed reflector. This causes the rays of light to be directed on a much larger reflector in the cap, which distributes the light uniformly on each panel. The objectionable "lamp spot," or halo, is thus done away with, and the even glow is pleasing to the eye in spite of the brilliancy of the light.

THE province of Saskatchewan, Canada, pays a mother twenty-five dollars every time she gives birth to a child; it also pays the attendant physician a fee of fifteen dollars.

The light of learning will gleam like a beacon from this school lantern and its twin



When the train approaches, a bell rings, a signal light flashes, and the arm of the pole drops down, thus lowering a number of heavy spiral wire tell-tales which should stop the most reckless motorist



Railroad Gate Warns and Stops Reckless Motorists

A NEW safety gate has been put in use on crossings to warn motorists when a train approaches and stop them if they do not heed the warning. Electrical contacts are fastened to the railroad track a few hundred feet from the road crossing. When a train rolls over them, current is sent to an iron box on a pole at the side of the road. A bell clangs loudly—this is the warning—and at the same time, a long steel arm swings out over the road. At equal distances along the arm "tell-tales" are hung. These are steel wires wound in a spiral, usually about eight feet long. A motorist, no matter how reckless, will think twice before he risks these tell-tales. At night, in case an automobile driver should misunderstand the bell, a bright ruby light shines down the road, while a white light, fixed at right angles to the other, illuminates the safety arm and dangling tell-tales.

When Will This Reservoir Be Emptied?

SUPPOSE we have a reservoir a mile square and one mile deep and we assume that the water in it does not evaporate and is not added to by rain or other causes. Again, let us suppose that there is an outlet in the bottom of the reservoir through which the water escapes at the rate of one hundred gallons per second (more water than most families use in a day). When will the reservoir be empty?

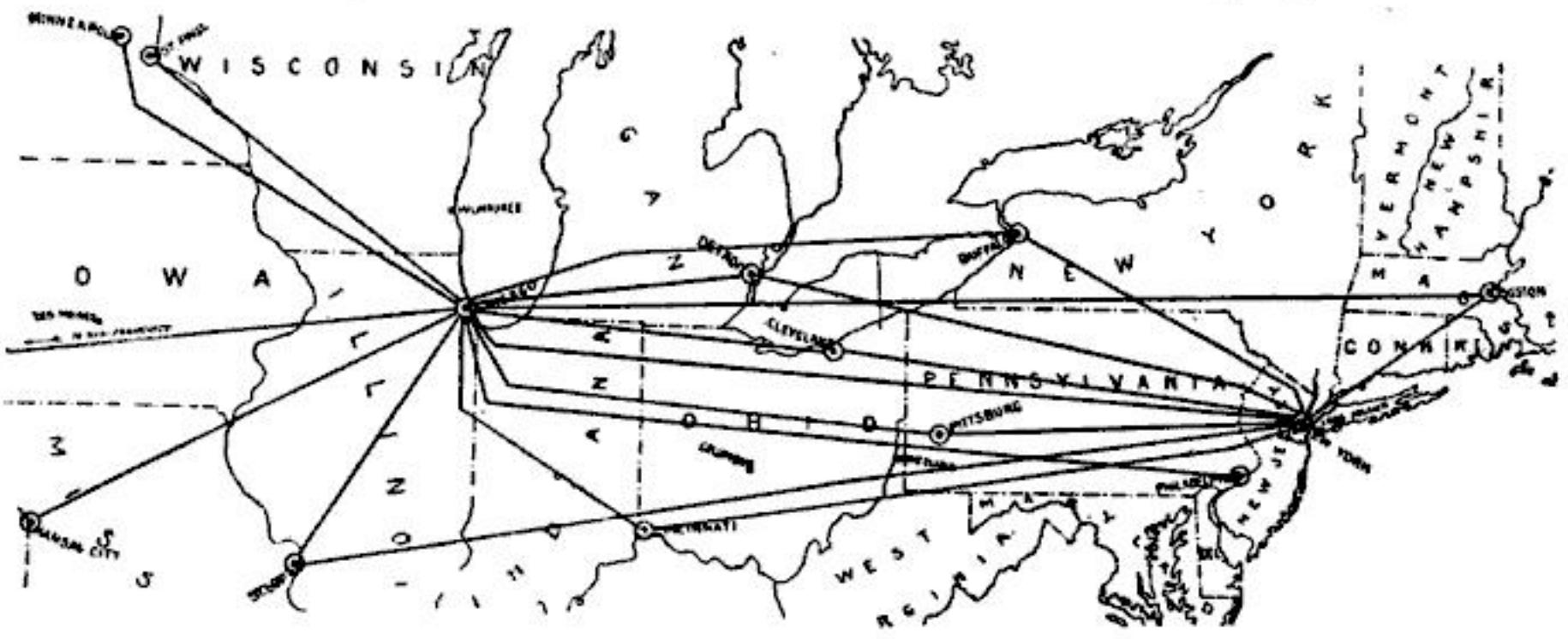
A few minutes work with pencil and paper will suffice to show that you would never see the bottom of this artificial lake—no, nor your great-grandchildren. In fact it would take some three hundred and fifty years to empty the tank.

Typewriting Eight Telegrams Over a Single Wire

WHEN the possibilities of sending messages over a wire by electricity were first realized, soon after Morse demonstrated the first telegraph, the limitations in the message-carrying ability of a plain circuit were encountered. The ordinary good operator could send only about one complete message per minute, and to do this he required the full use of a wire connecting him with the receiver. Each line was thus limited to about four hundred messages per business day, and it became clear that extremely high rates would have to be charged for messages over expensive long distance wires. The greatest cost of the telegraph system was due to the erection and maintenance of the lines, and therefore the best way to make lower charges possible appeared to be to increase the number of messages which could be handled on each wire.

The first step toward solving the problem of message limitation came with the duplex telegraph, which made it possible for four Morse operators to use a single wire at the same time. In this system two streams of messages pass over the wire simultaneously, in opposite directions, so that the capacity is doubled. The next step was the quadruplex, in which four messages are sent simultaneously, two in each direction, over the same wire. In this system one line carries about sixteen hundred messages per day, and large saving, as compared to plain or simplex single-message telegraphing, results. The duplex and quadruplex are very greatly used today, and the latter is not easy to keep in full operation during rainy weather. An octuplex system was devised, but has not been found practical.

Since the hand-telegraph systems are limited in message capacity by the speed of the Morse operator, automatic receivers and transmitters were devised to speed up the impulses passing over the line. In the Wheatstone system, which is perhaps the most successful of the plain automatic telegraphs, it is possible to send three hundred or four hundred words per minute over one wire, thus increasing the normal capacity some ten or twelve times. In this system the messages are first punched into special tapes by perforating operators. The tapes which are simultaneously punched out by ten perforators, will usually keep one wire in full operation. At the receiving station the messages are printed in dots and dashes on a second tape; this is divided into suitable lengths and distributed amongst a number of transcribing operators who



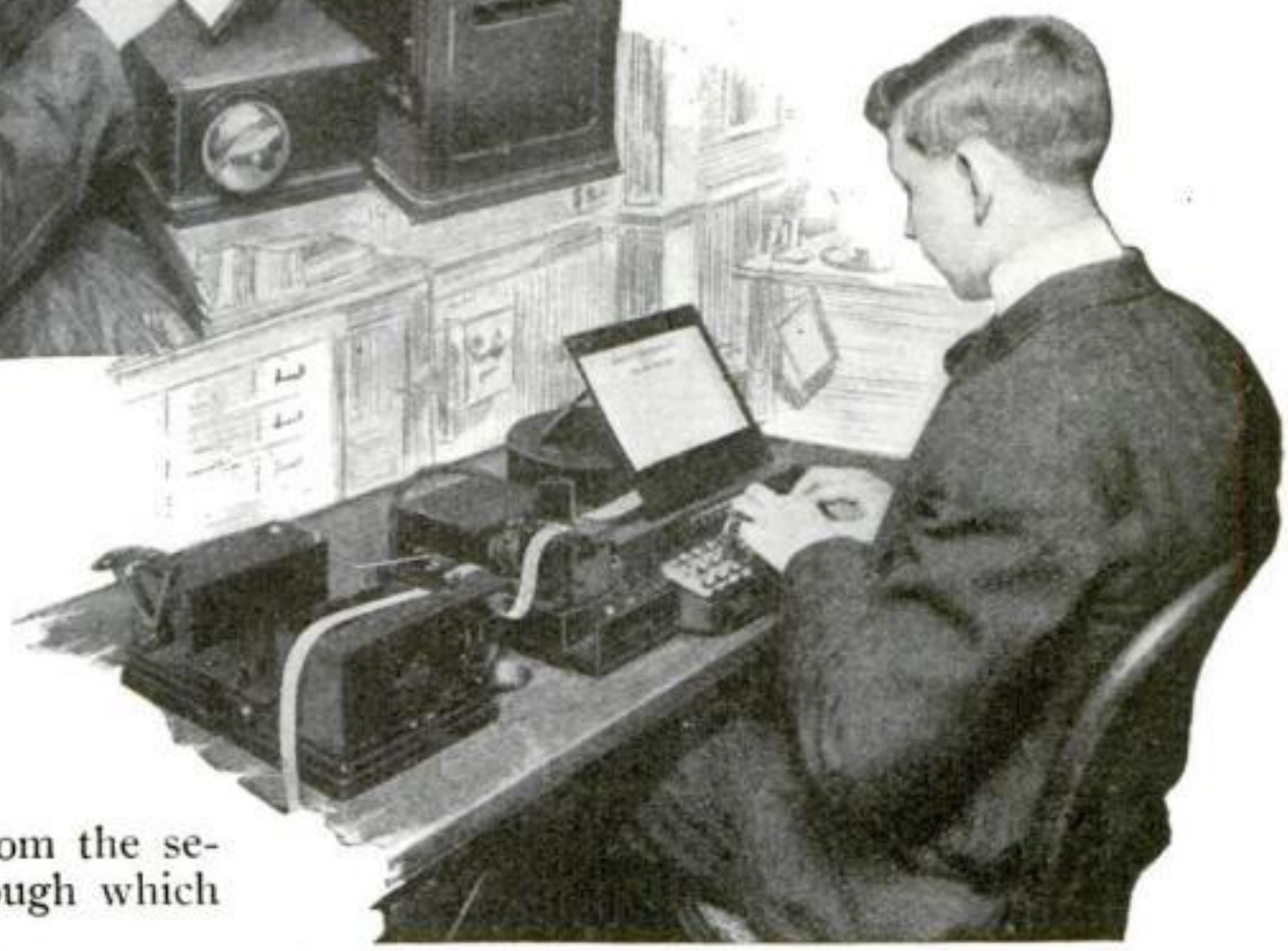
This remarkable telegraph system has been in operation over the lines shown for many months, and has resulted in the saving of much time and money to the company, and eventually to the senders

translate the Morse code and write out the messages for delivery. The system is entirely practical, and is used in connection with the ocean cables. In the United States it is not favored for inter-city telegraphing because of the loss of time which results from the series of processes through which messages must pass.

The receiving instrument. A telegraph blank is inserted in the instrument, and as the perforated tape passes through after receiving its impulses over the wire, the message appears in typewritten form, ready to be delivered

Automatic telegraphy suggested printing telegraphy, in which the message received appears in typewritten form. The first of these instruments, like the stock-ticker, printed their messages on paper tapes. Soon it became possible to operate page-printers over considerable distances by wire. In these a typewriter keyboard transmitter, either directly or through a punched tape, operates over the line a typewriter receiver. The message is thus printed ready for delivery almost as soon as the transmitting operator punches it out on the sounding keyboard. Such printing systems usually operate up to fair typewriting speeds of fifty words per minute or so, and can be duplexed. By their use much time and expense in message handling are saved, and the good features of present-day rapid wire line service are largely due to these installations.

The newest and most perfect page-printing telegraph is that which the Western Electric engineers have recently completed. In this system a single wire is used not only to carry eight messages simultaneously, four in each direction, but to print them on blanks at the receivers, ready for delivery. Thus the speed of direct printing operation (fifty words per minute) is combined with a distribution of one telegraph line among eight pairs of sending and receiving operators. The increases of speed and economy produced by such an arrangement are almost self-evident.



A sending operator at the keyboard perforator. This instrument is much like a typewriter, but instead of printing the letters a group of punches are controlled by the keys and punch a tape with various combinations of holes

The apparatus used in this new quadruple-duplex system is built up in a group of transmitting, receiving and accessory units. One of the illustrations shows a sending operator at the keyboard perforator. This instrument is much like a typewriter, but instead of printing the letters a group of punches are controlled by the keys and perforated on a paper

tape with various combinations of holes. In the illustration the fresh tape may be seen unrolling from the reel back of the rack carrying the message about to be sent. After perforation at the left end of the keyboard machine, the tape passes under the pivoted arm of an automatic stop and then into a transmitter unit (at the extreme left of the photograph). The operator ordinarily punches tape at about the speed of transmission, so that a little slack tape hangs under the control arm of the stopping device. Should he fall behind, however, as soon as the transmitter uses up the loose tape and so begins to stretch it tightly between the two machines, the control arm is lifted. This operation automatically stops both the local transmitter and the receiver at the distant end until more letters are perforated. Then the tape slackens, the control arm drops and transmission begins again. Thus the printed message appears complete and without blanks, even though the transmitting operator is forced to stop in the midst of perforating.

These eight operators work at one end of a single trunk line. Four are sending and four receiving, and they are kept busy every minute. The same number work on the other end of the wire, and it is possible to send more than six thousand messages over one wire in a single working day

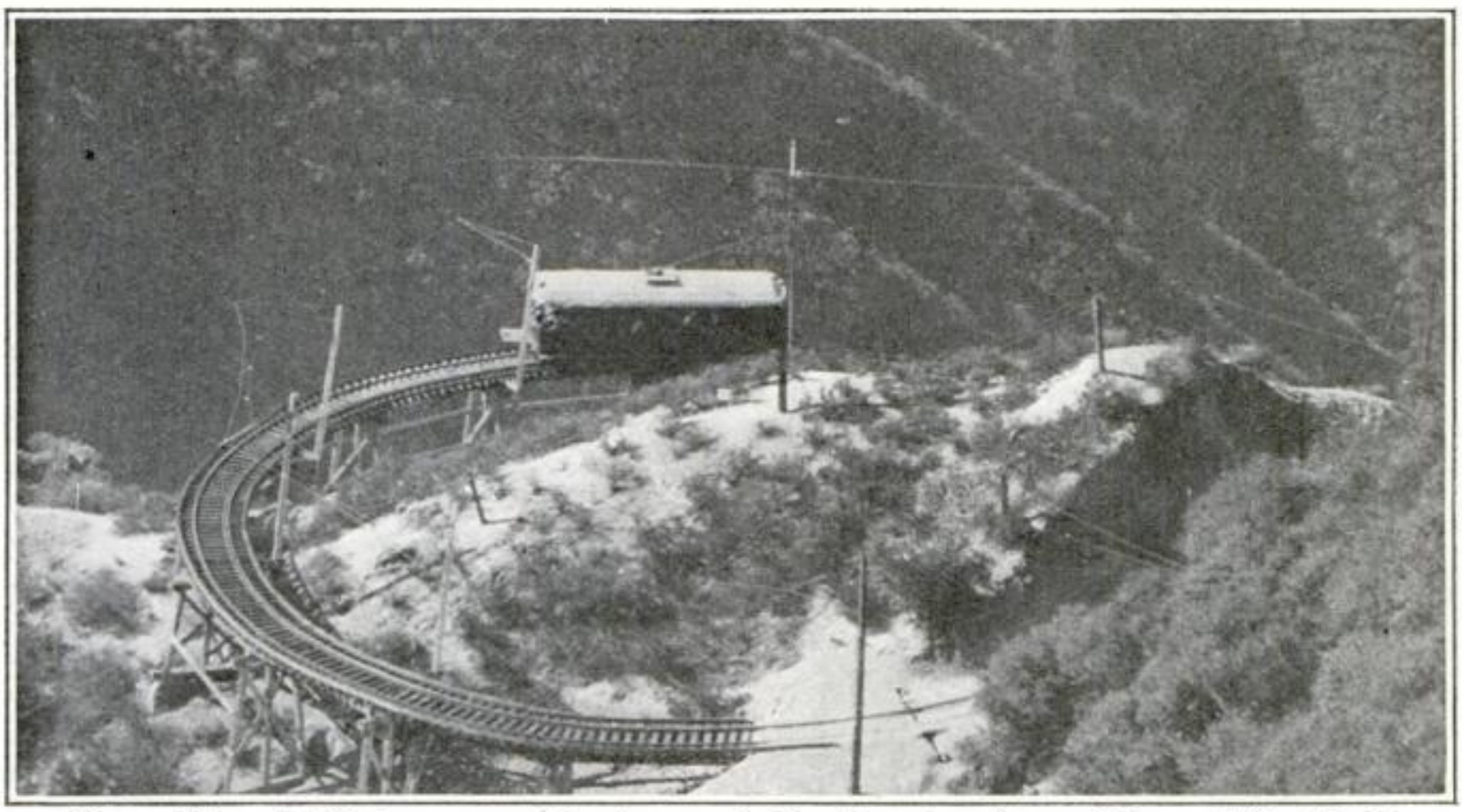
The printing receiver is shown in another photograph. Inside the case a message is being typewritten as the perforated tape corresponding to it passes, letter by letter, through the transmitter. Each group of five impulses (one for each row of punched holes in the sending tape) prints a single letter, makes a space between words or starts a new line on the printed page by returning the paper-carriage to the right and turning up the paper. At the end of each message a short time is allowed for the receiving operator to take out the printed telegram and insert a fresh blank; while the new message is being typed he checks over that which has just been received and, if it seems correct, turns it over to the delivery department.

The printing, ready for delivery, of keyboard-perforated messages, could be accomplished by any of the older successful page-printing telegraph systems. In fact, the same line could be duplexed and messages sent at about fifty words per minute in both directions, so keeping four operators at work on a single wire. But the new printing telegraph is capable of handling the telegraphic output of eight transmitters and thus keeping sixteen operators busy over one line. This simultaneous transmission of messages is made possible by the use of a pair of special distributors, one at each end of the line, which successively switch in and out each of four sets of instruments. The line is duplexed and therefore permits messages to travel in both directions at the same time; for each

quarter revolution the distributors connect on the line four operators using one duplex "channel" set, which consists of a sender and receiver at each end.

The operation of the two distributors is perhaps the most important new thing in this system, since it is through them that the line can be used successively by each of the four groups of four operators. The simple fact that in printing telegraphs over three-quarters of the total time of operation is used for preparing to send, and in printing the letters, while less than one-quarter will suffice for the actual transmission of the five electrical impulses, has made possible this distribution and simultaneous operation. The distributors are merely special rotary switches which revolve, one at each end of the wire, at exactly the same effective speed. For each quarter revolution the duplex line is connected to one set of instruments and the impulses forming one letter are transmitted in both directions. If the distributor rotates at three hundred revolutions per minute, three hundred letters or fifty words per minute will be sent in each direction through each of the four channels, making a total of four hundred words per minute. Each revolution of the distributor is accomplished in one-fifth of a second, and during each quarter of this period, or one-twentieth of a second, each set of instruments is connected to the line. In the three-twentieths of a second the receiving printer operates and the transmitter prepares to send the set of five impulses corresponding to the next letter in its message.

The other photograph shows the eight operators, four sending and four receiving, who work at one end of a trunk line using this new quadruple-duplex printer.



The problem of bridging a mountain stream, circling the edge of a precipice and "tacking" up a steep grade forced the engineers responsible for the electric railway up Mt. Lowe to make this queer "circular bridge"

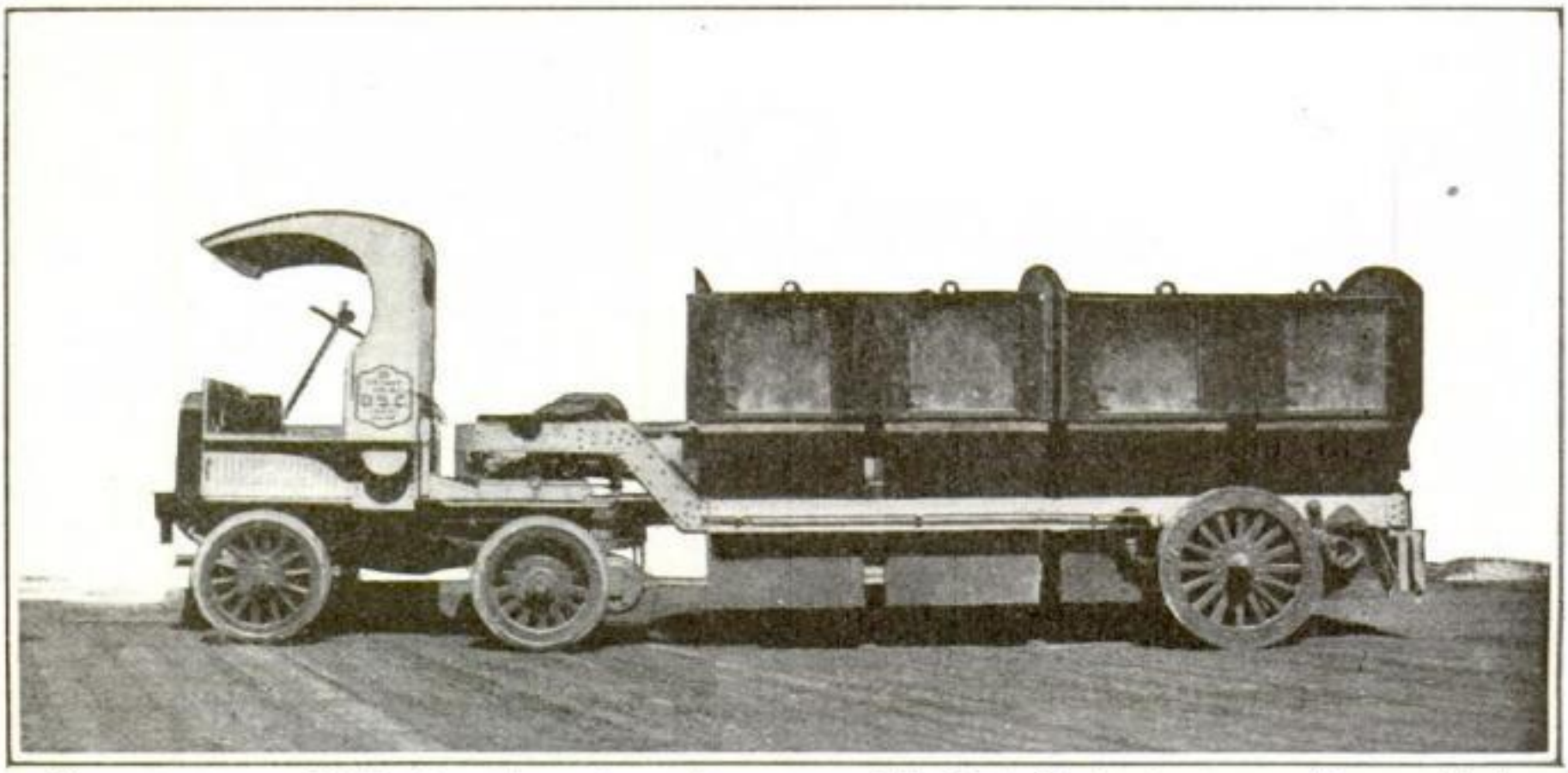
A Circular Bridge on Stilts

THE circular bridge shown in the illustration is unusual both in its design and in its location. The trestle work forming almost a complete circle, practically all of which is "on stilts," is a part of a mountain inclined road. At the point where the roads almost meet, one track is about six feet higher than the other. The circle formed by this track is seventy feet in diameter.

This bridge is also noteworthy because it is located nearly five thousand feet above sea level. It is a portion of what is known as "The Mt. Lowe incline railway," a line which winds its way up the side of Mt. Lowe. The turn seems to show how crooked is this three-mile line.

Cleaning New York Streets with Modern Mechanical Appliances

COMMISSIONER J. T. FETHERSTON, of the Street Cleaning Department, of New York City, recently began the operation, in a so-called "model district," of machinery for collecting refuse and cleaning streets. There is nothing just like it in this or any other country. The ideal which the commissioner undertook to demonstrate in this district, which took in many phases of the city's life, Fifth Avenue stores, wealthy homes (such as that of J. P. Morgan), tenement houses and factories, was a dustless job, with refuse collections made in a given locality day after day with the regularity of a train schedule, at a minimum of cost and a maximum of efficiency. For refuse collection, for instance, he replaced horse carts with motor trucks of great capacity, and capable of transporting every kind of refuse simultaneously.

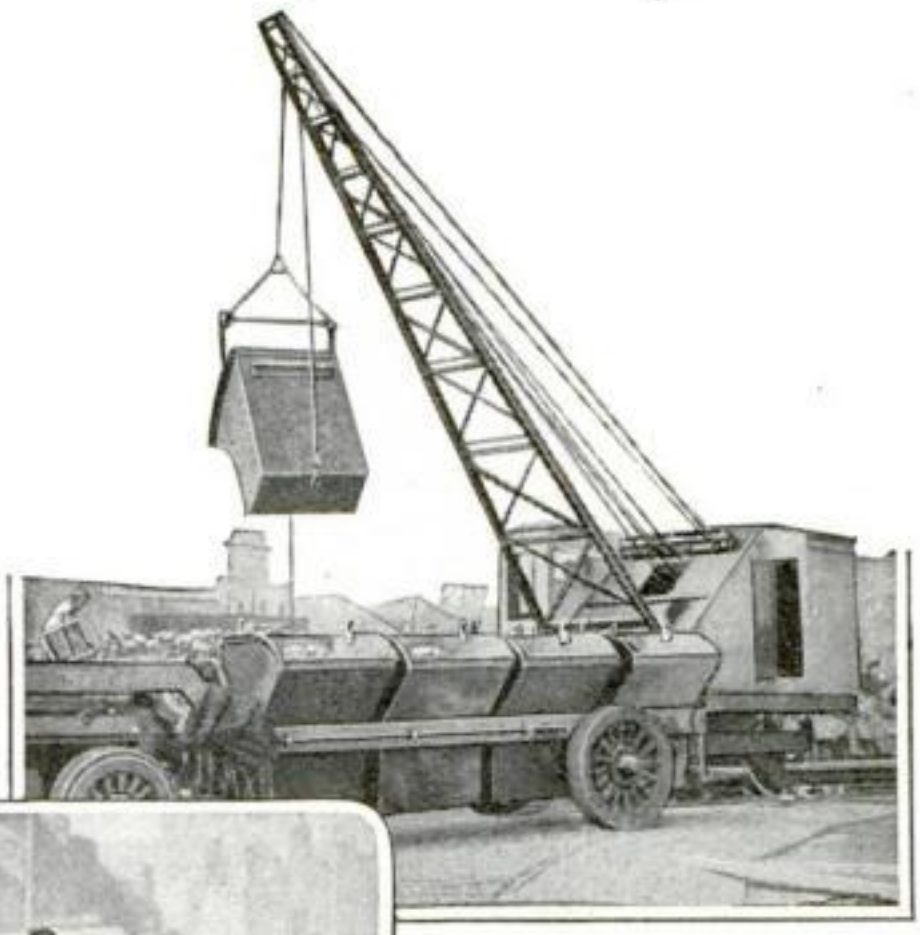


Huge tractors of this type have recently appeared in New York streets, and have aided wonderfully in the refuse removal work of the Department of Street Cleaning. They are so built that the driver has no control over the gasoline engine. He simply operates the electric current, thus making the power machinery more nearly "fool-proof"

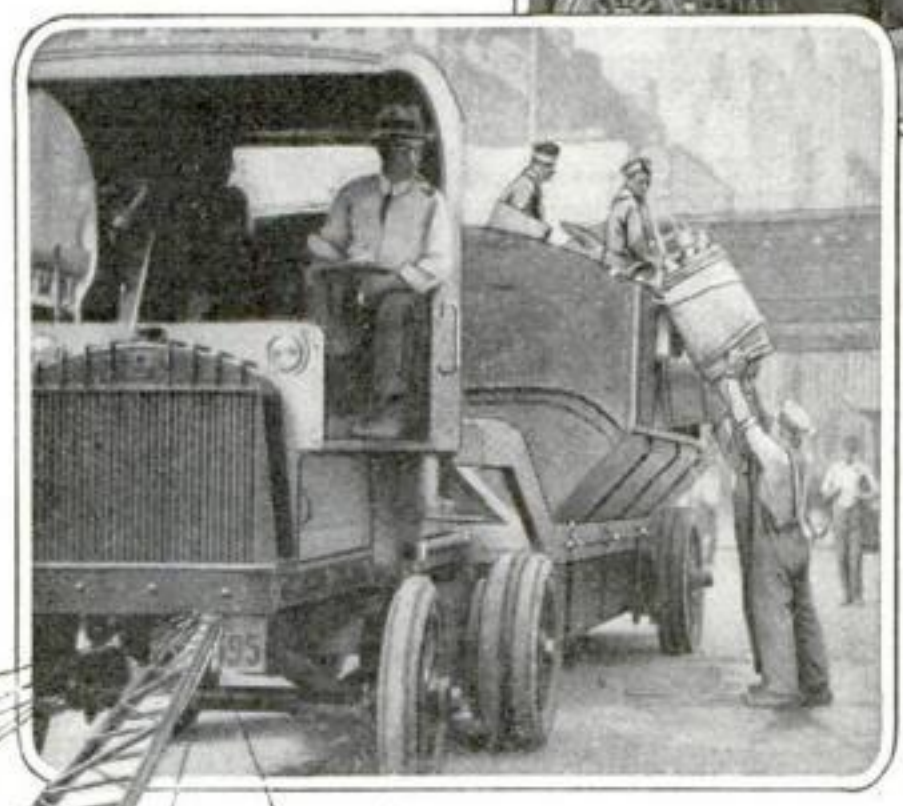
His problem was solved by the combination of a gasoline-electric tractor and trailers designed to perform the different functions required. As it is intended that the streets shall be cleaned by power, and that power plows shall be employed when snow is to be removed, economy and efficiency suggested that the tractor be designed to meet the needs of all these services, and be available for twenty-four hours a day, if required.

The tractor, therefore, is a power plant on wheels and provided with a heavily constructed fifth wheel by means of which the different kinds of trailers can be attached. The tractor has a wheel base of only seventy-two inches, in order that the long trailer may be swung around in a thirty-foot street. The power plant consists of a four-cylinder, forty horse-power gasoline motor coupled to an electric generator on the same shaft. The generator supplies power for driving the tractor and the motors used in operating the flushing and sweeping machines. Such a type of tractor combines the simplicity of control of an electric vehicle and the relatively large mileage capacity of straight gasoline equipment. The motor is equipped with a governor and special devices which automatically regulate its speed according to the load. The motor may be started at the stable. It runs slowly until the driver moves the controller, turning the electricity into the driving motors or into

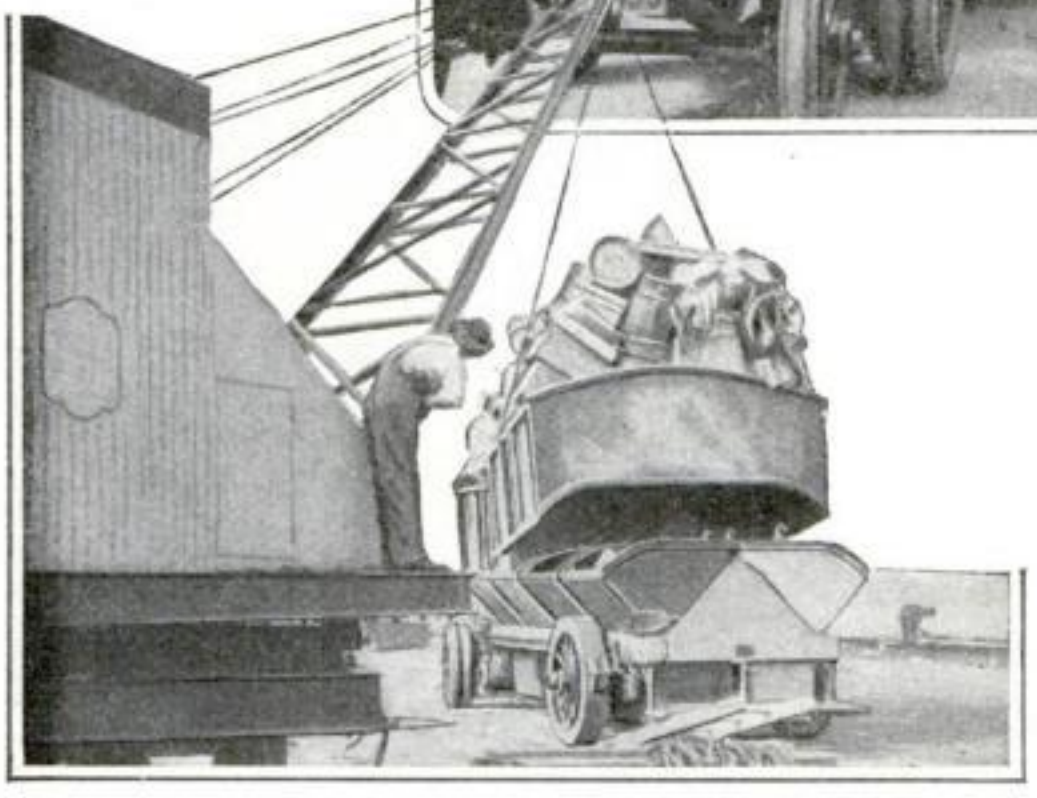
the motors on a trailer. It then automatically starts up at full speed of nine hundred revolutions a minute. When the electricity is switched off, the speed is again automatically reduced. The driver has no control over the operation of the gasoline engine. He controls the electric current alone. The value of this is that the power machinery is made more nearly "fool-proof." A less skilled man may be employed to run the machine, for the job consists simply in steering it, switching on and off the electricity and applying the brakes when necessary. The machines cannot be run above eight miles an hour on an ordinary level paved street.



On the piers the refuse is discharged into barges by locomotive cranes which take their power from a third-rail. The various sections of the trailer are lifted bodily and their contents dumped into the barge. The rapidity of operation and the fewer men employed actually reduce the cost of the work



A crew of five men accompany these great tractors, and refuse is emptied into their ample bodies with great rapidity. The upper trays receive barrels, boxes and papers, and the lower sections the ashes and garbage



The refuse trailers, which have already been placed in operation, consist of a massive steel-frame arranged to carry a series of eight deep rectangular steel cans, and, resting on top of these, two big trays for barrels and boxes. In the sides of these big trays are rectangular openings by which the ashes, street sweepings and garbage can be thrust into the cans underneath. These openings are closed by swinging steel doors horizontally hung so that the pressure of an ash can or a shovel will open them, and gravity will close them instantly when the pressure is removed.

On the piers where the refuse is discharged into the barges are four locomotive cranes taking their power from a third rail. The various sections of the collecting trailer are lifted bodily and their contents dumped on to the barge.

Twelve of the tractors and refuse trailers are now in operation, and the crew of five men go through a block with a speed and resultant cleanliness marvelous to the eyes of New Yorkers accustomed to the antiquated methods in use elsewhere in the city.

ONLY ten per cent. of the inhabitants of the Phillipines speak Spanish.

Will Germany Live on Sewage?

THE problem of securing food, which confronts Germany, has occasioned a thorough, scientific investigation of the subject and its economic solution. The scarcity of fats has been especially felt, due partly to the large consumption of fat-containing foods by German people. Direct sources of fat, such as olive oil, have ceased to be imported, and indirect sources, like meats, nuts and grain, though domestic products, are diminished in their output. The dry summer affected the fodder for grazing animals, especially since more vegetable food has been consumed by the entire population than formerly.

One of the first questions considered was whether the fat consumed was necessary for proper nourishment. Physiologically, fat stands next to protein in importance, the other foods being carbohydrates (starches and sugars), salts and water. The Germans as a people, consume more fat than other nations,—in fact, all people eat more oily food than is necessary. Nevertheless, for energy-production, 3.6 ounces of fat are equivalent to 8.8 ounces of carbohydrates. Fat also prevents too rapid breaking down of the protein in the body, which fact, together with its resistance to cold, makes it highly important for the troops in the field.

In Germany today, the consumption of oil, butter and other fatty foods, per day, is less than two ounces, though formerly it was nearly double that amount. It has been found that a strict economy would practically solve the problem. If the rich would not waste food, the poorer classes could be relieved. Large crops of linseed, hemp, poppy, mustard, sunflowers, walnuts, beech-nuts, hazelnuts and even Indian corn and sesame, all containing oil in varying degrees, will be reaped this year. They require land, however, which would otherwise be used for other necessary foods. Peach-pits and the seeds of other fruits have been considered as sources of oils, but as yet little has been done in that direction.

The committee in charge of the food question, authorized the Agricultural Banks to buy and distribute last year's crop of beech-nuts and flax. Beech-nuts have heretofore been wasted, but now even the royal Prussian forests are to be stripped, and their output placed at the disposal of the committee. School children have been enlisted to gather nuts and turn them in to the common store. A ton of fresh beech-nuts brings approximately from fifty to sixty dollars; air-dried nuts, from seventy-five to eighty-five dollars. Provision has also been made for gathering the sunflower harvest.

These measures pertain more to the future than to the immediate needs, however. Accordingly a general collection of fatty refuse from meat-shops, slaughter-houses, hotels, etc., has been ordered. The system used is the work of Bovermann. The refuse, mixed with water, passes through a receptacle very slowly to allow the fatty substances and oil globules to rise to the surface, while the heavier bodies sink to the bottom. The top layer can then be drawn off and the fat easily extracted and purified.

This method, of course, only takes care of a fraction of the fats which may be found in refuse. The slime at the bottom could also be used for some purposes, such as feeding swine. All sewage from households and manufactories is largely impregnated with fat in various forms, such as soap particles and oils. According to Professor Bechhold, in *Die Chemiker-Zeitung*, .35 ounces of fat per person, are wasted in sewage, every day. In peace times, such waste would be fourteen million, two hundred and eighty thousand dollars, while in the last few months, it would be forty-seven million, six hundred thousand dollars. A further stringency may necessitate the use of sewage also.

The fisheries are another source of fat and also protein, which as yet remain unclaimed. Only one-fourth of all catches are used for food, though the small fish, thrown back, contain much available nutriment. Even bones and various hides could be made to yield some fat, if their use became imperative.

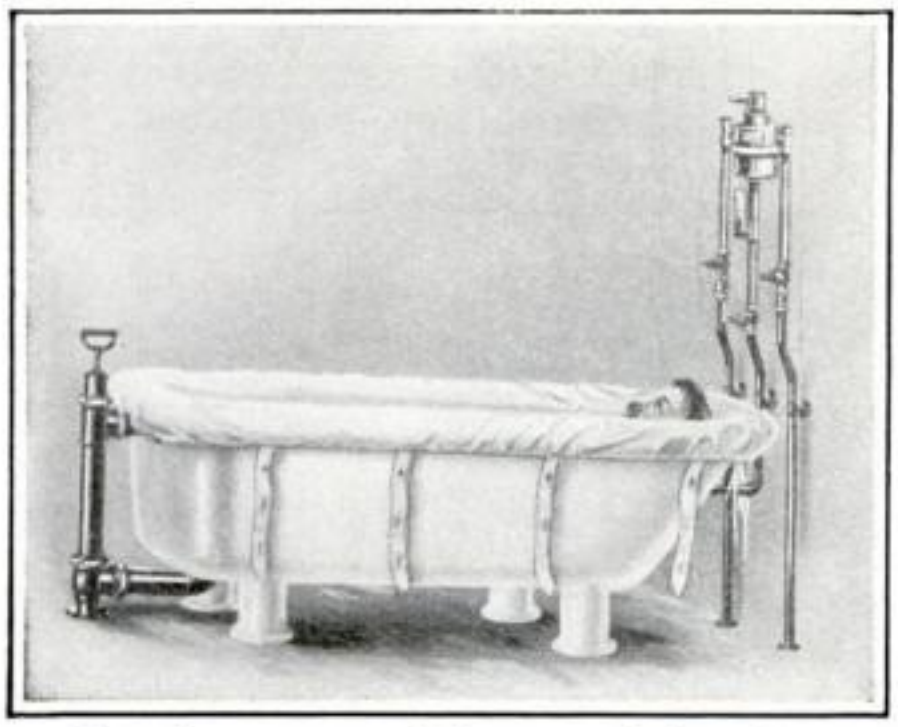
Sleep in Hot Water to Rest Your Nerves

SLEEPING in a bathtub full of water kept at blood temperature is claimed by some physicians to give the required amount of rest in half the time that sleeping in bed requires. In other words, four hours sleep in a bathtub filled with water at the proper temperature—and always maintained at that temperature—will result in the exact amount of restfulness that eight hours in bed will give.

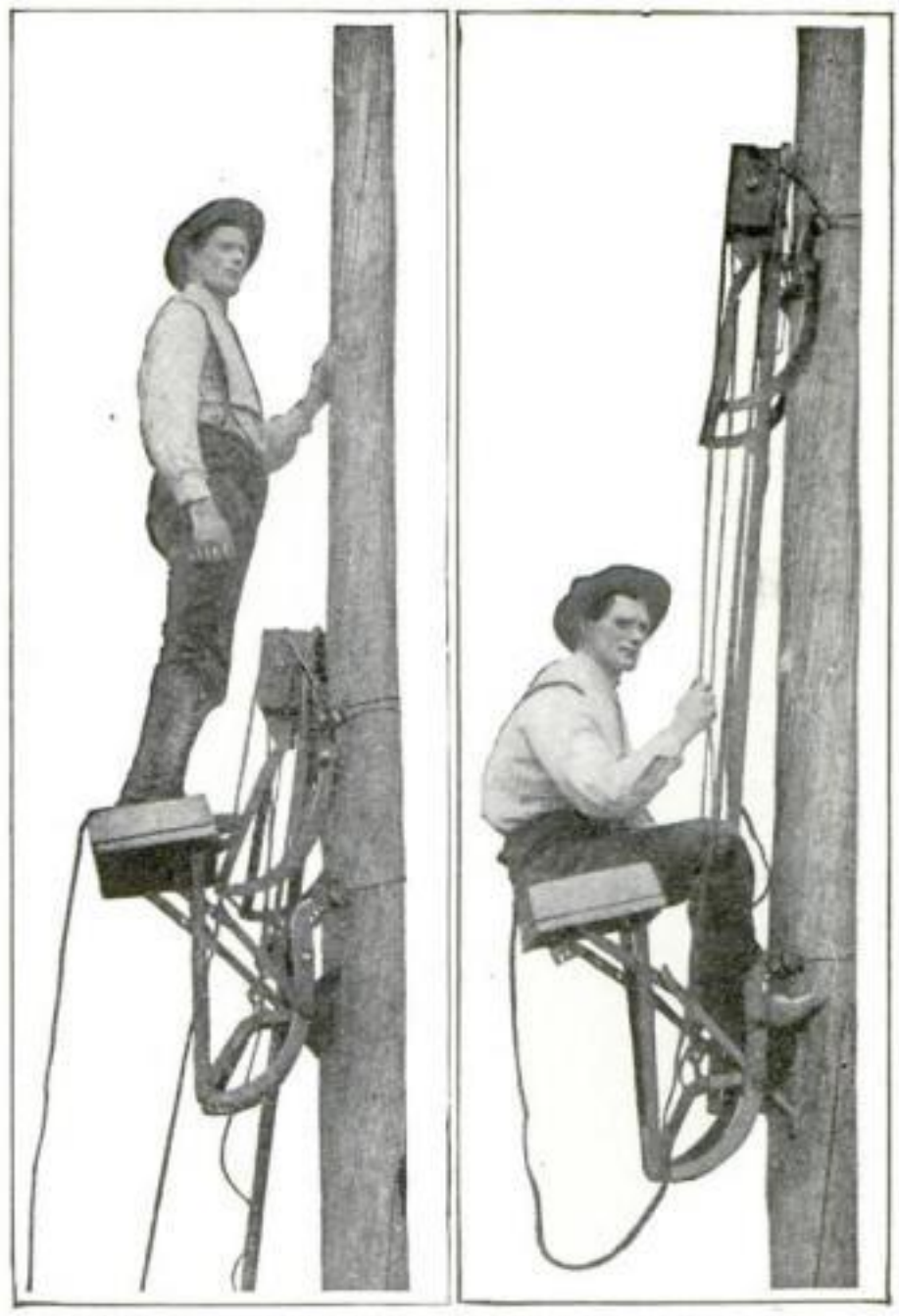
The explanation is that warm water completely relaxes the nerves, which ordinary sleep does not necessarily do. The most difficult part of this treatment is in maintaining the water at a constant temperature, and for the purpose of accomplishing the result, a middle-western manufacturer has recently brought out on the market a thermostatic water control apparatus, which, as its name implies, maintains the water at any desired temperature.

In practice, the patient climbs into a bathtub filled with water, his head protruding through a hole in a rubber blanket, which is strapped around the edges of the tub. Water constantly flows in at one end of the tub, and out at the other.

For the harried business man, who complains that his working day is too short, such a sleeping couch as this should have a distinct appeal. He should be willing to rest four hours at least.



Here is a system of heat regulation that makes it possible to sleep in a bath that is always at the same temperature



With this invention, telephone line work is as comfortable as sitting or standing in the shop would be

A Machine Which Climbs Poles

A POLE or stack-climbing apparatus in which the pole or stack climber sits comfortably while elevating or lowering his position, as the work progresses, by a simple arrangement of clutches, has been constructed and put in use by a young telephone lineman in Arizona. The climber (the machine, not the man) consists of two parts, an upper and a lower. The mechanism in the upper part contains clutches which grasp the pole firmly, being manipulated by ropes from the seat below.

To climb the pole, the lineman or stack-climber takes his seat as far above the ground as possible in order to expedite matters. The clutch mechanism is pushed upwards as far as he can reach by means of a wooden pole. The clutch is then set, and with a rope and pulley arrangement, he elevates the seat. By continually repeating this operation, pushing the clutch box upwards as he progresses, he literally crawls to the top of the pole or stack.

Running a Newspaper Plant with an Automobile

AS a result of a blizzard last December, all of the towns along the New York, New Haven and Hartford Railroad between Stamford and Mount Vernon were without electric light and power, since they draw their supply of current from the high-tension system of the railroad. Mount Vernon, which has its own municipal plant, was the only exception.

This little automobile furnished the power for an entire newspaper plant, which had been crippled by a blizzard

The publishers of the *News and Graphic*, of Greenwich, Connecticut, were unable to operate their presses. Manager Barton thought of utilizing a portable gas engine, but this was not to be had. He happened to drop into an automobile agency. The manager offered the services of a touring car. A few minutes later the machine was backed up in front of the newspaper office and one of the rear tires was removed. With very little difficulty the jacked-up wheel was belted to the main driving pulley of the shop, the other wheel being allowed to rest on the ground. Soon the twenty horsepower engine of the small car was running not only the two big cylinder presses, but the folding machine, the power cutter, and several small job presses as well. Needless to say, the paper appeared on time to the amazement of the citizens of Greenwich, who had not expected to see newspapers for days.

Wandering Motion Pictures

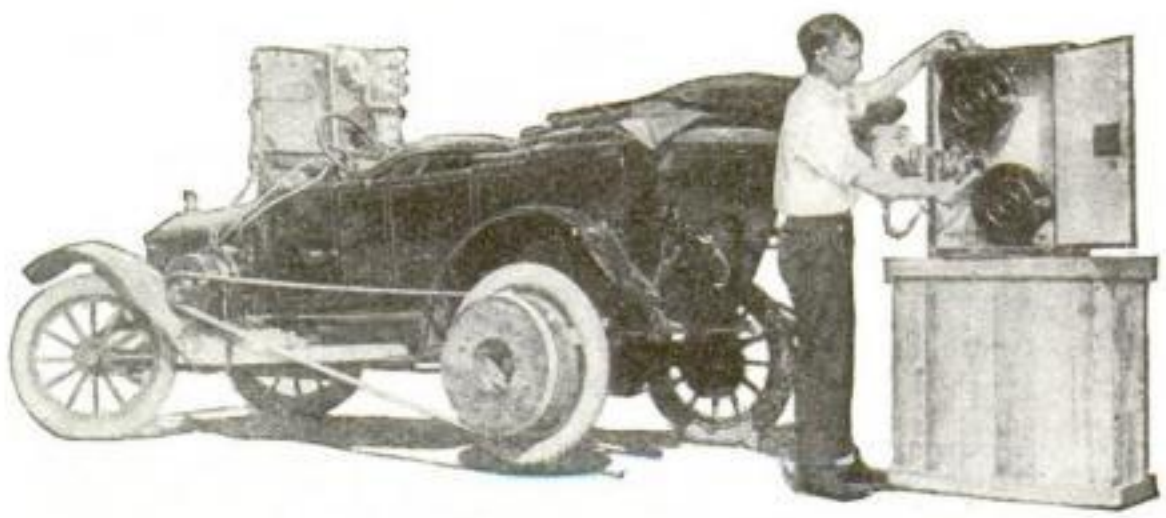
CARRYING movies to the people by automobile is the latest advertising scheme of a well known motor car manufacturer. The car not only carries the apparatus, but supplies power for driving an electric generator which furnishes the projecting light.

A small dynamo is bolted to a two-inch plank, which in turn is fastened to the running-board of the car. A pulley attached to one of the rear wheels of the auto, which is for the time being jacked up from the ground, is belted to the generator and the power for driving is thus transmitted from the car's engine.

The switchboard controlling the current is hung upon the windshield and the screen is attached to any covenient building or billboard.

Scenes about the plant of the manufacturer are shown upon the screen and it is claimed that the entire outfit can be unpacked and put into operation in a few minutes.

THE largest commercial gasoline-engine has been built for installation in a double-ended ferry-boat used for the transportation of trains across an arm of San Francisco Bay. This engine weighs nearly fifty tons and develops six hundred horse-power.

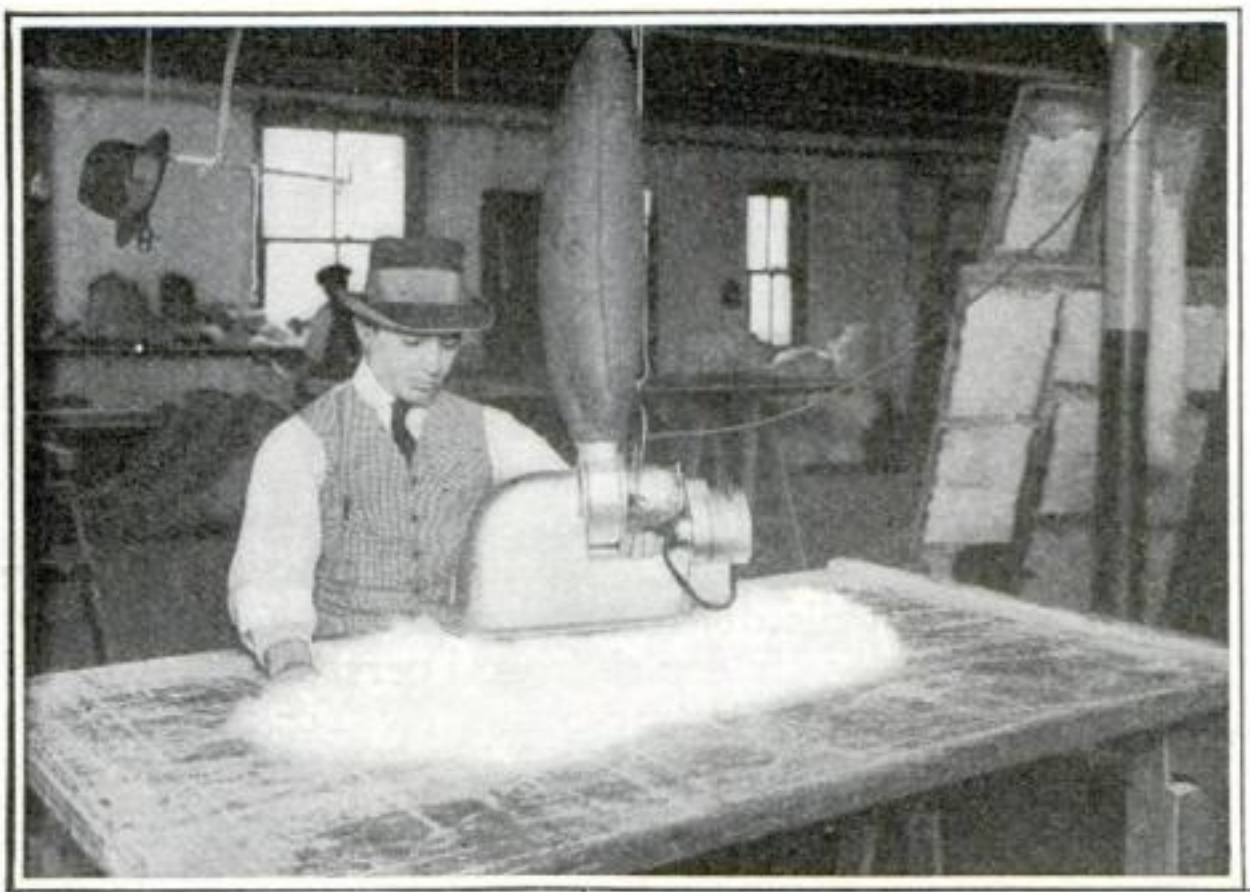


This car not only carries the apparatus, but generates the power for the motion picture machine

The Peril of the Fur Coat

By A. M. Jungman

DID you ever see a rosy-faced child with a pretty white fur piece around its neck and its hands thrust deep into the comforting warmth of a white fur muff? An altogether innocent and charming sight, you would think. It is rather a disillusionment to find that death and disease lurk around that snowy fur. Not for the child, to be sure, but constantly, from the minute that fur was opened in the garment furmaker's shop to the minute when it is placed around the little one's neck, at least one person's health was in danger because of it.



The new method of beating fur. The machine is designed on the principle of a vacuum cleaner. A rattan beater inside the machine beats the fur and the particles of dust and fur are sucked up into the bag instead of filling the air about the workman as was the case with the old method

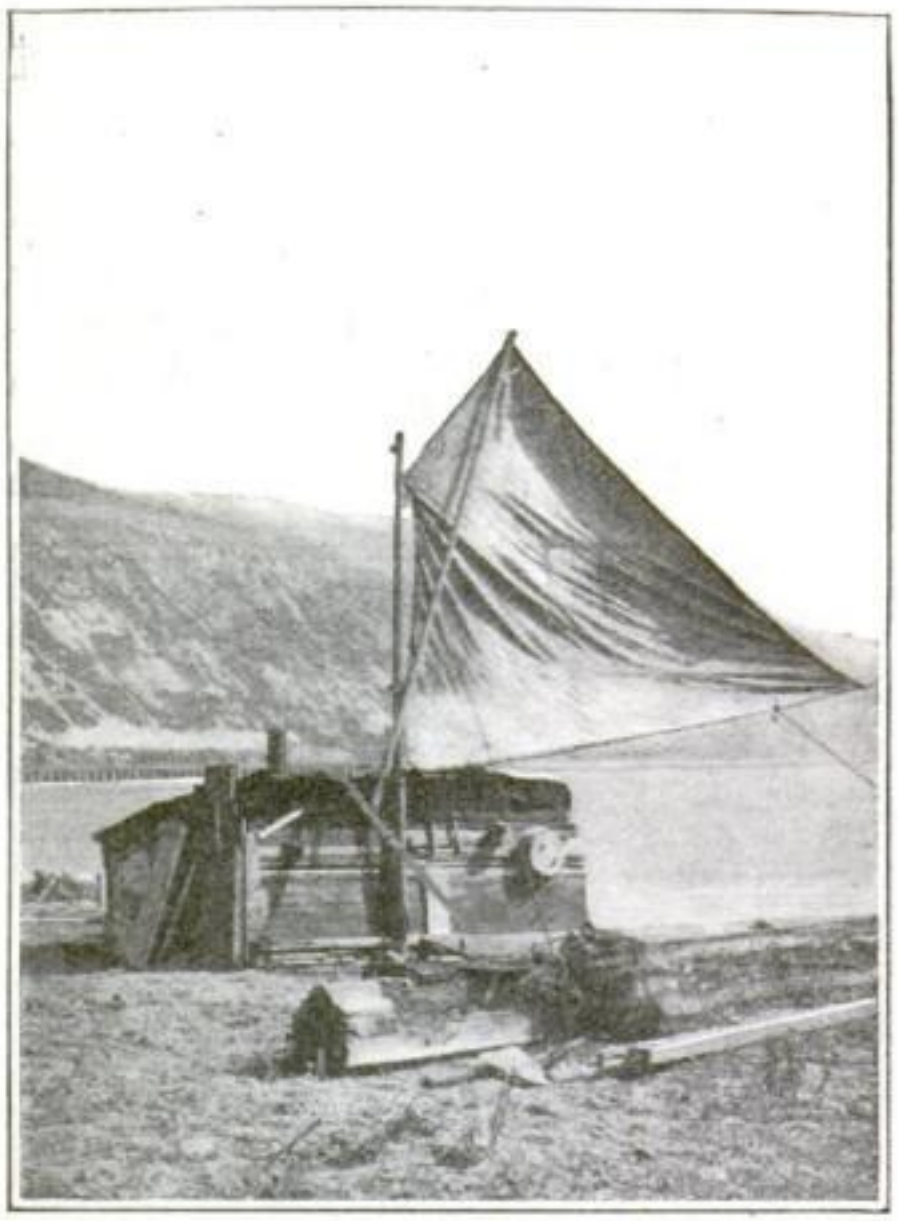
That this particularly dangerous trade may be made comparatively safe has been discovered by the physicians of the Occupational Clinic of the Department of Health of the City of New York. With a view toward obviating many of the hazards which surround the fur garment makers, an exhaustive study has been made of the fur and allied trades in this city.

In the garment makers' trade the workers have better surroundings than do the hatters' fur workers. Their perils are to be found in the making of childrens' sets. These are made of angora skins and other pelts. The angora skins are brought from China, and when they reach the factory they are more or less curly. The hair is combed to straighten it and to give it an appearance of uniform fluffiness. For this purpose a combing machine is used. This means that a man holds the skin under a revolving cylinder on which are set fine

A fur worker beating fur by hand. The workman is not protected from the particles of fur and dust which are raised by his beating

wire bristles. If you want to see the fur fly, watch one of these combers. The floor on which the man stands is covered inches deep with fur and the air is thick with it. In passing through a room where one of these machines is in operation, one's hair, eyes, ears and clothing become full of the indescribably fine particles of angora fur which are loosened by the machine. Sometimes the operator wears goggles and a respirator; sometimes not. Some factories keep the combing machines in box-like compartments so the operator does not suffer.

Another harmful practice is the beating of finished fur garments by hand.



When the fisherman is not-a-fishing he takes off the sail of his boat and uses it as an awning for his house

The beater uses two rattan sticks with which he belabors the garment, causing hair and dust to fly into the air and settle all over him. Recently a machine has been invented which does away with the dirt and dust of the hand-beating method. It consists of a vacuum device in which is placed a rattan beater which can be operated at any one of three speeds electrically. The vacuum principle is employed to draw all the dust and particles of fur into a bag, instead of permitting them to be blown about the room. It is believed that asthma is contracted particularly by those persons who handle dyed wolf, racoon and coney skins. Unfortunately, many of the fur workers were exceedingly reticent and offered the physicians very little help toward determining their physical condition, fearing to acknowledge any ailment lest their working capacity might be curtailed. It is a noteworthy fact that of the workers in the fur and allied trades, seventy-two per cent were under forty years of age and ninety per cent under fifty. This is conclusive evidence that the fur and hatters' fur trades are dangerous to health. As getting rich at these trades is out of the question, so far as the workers are concerned, the only reason for such an early retirement from the work must be disability.

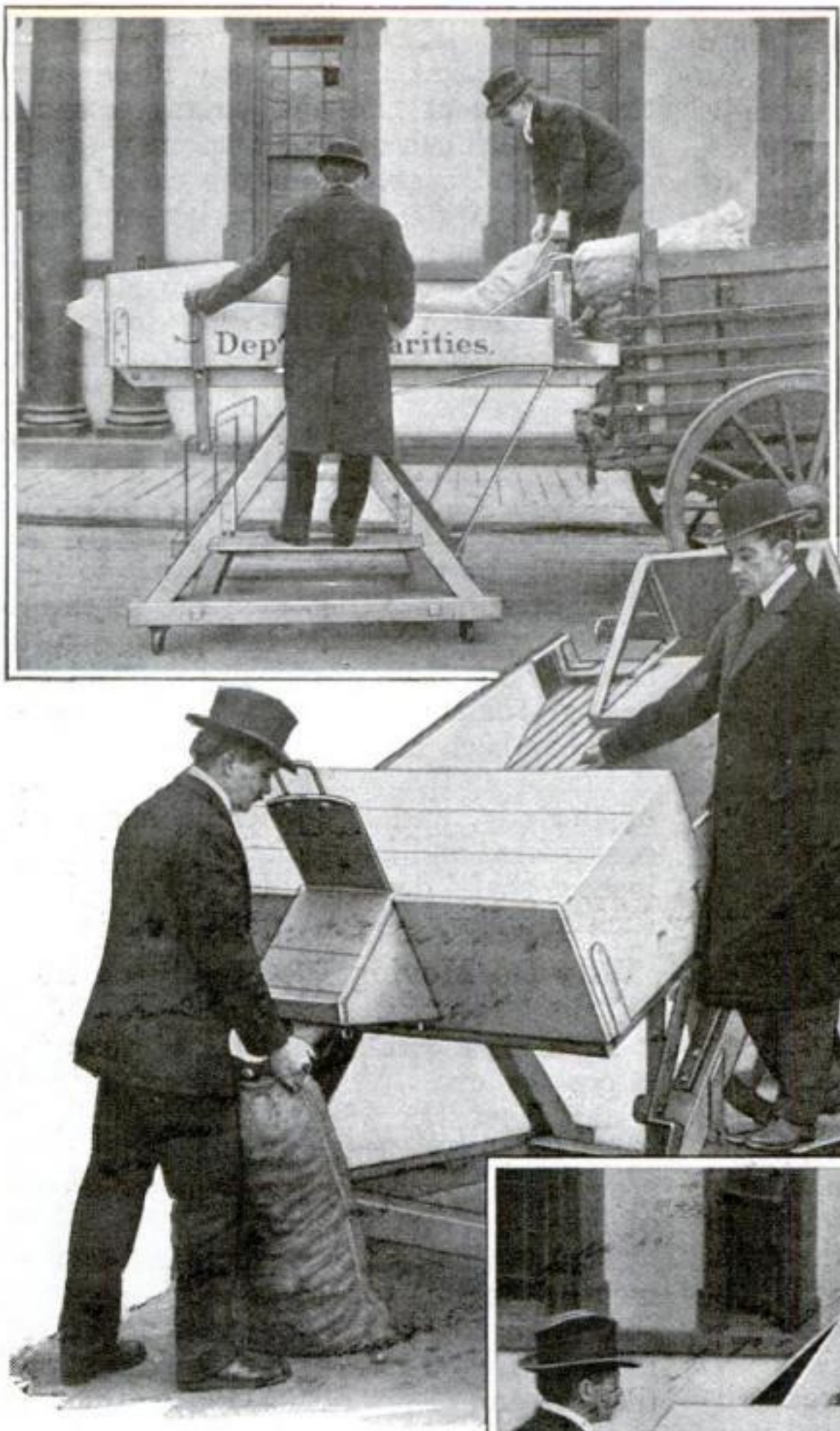
There are many ways in which the evils of the fur trades can be mitigated. As sixteen thousand persons are engaged in these trades in New York City, their condition is of vital importance to the public health. For this reason the Department of Health has made an exhaustive study of these trades and efforts are being made to improve present practices.

When one considers that some of the things suffered by the victims of mercurialism are diseased gums, black teeth, severe headaches, nosebleeds, violent tremors of limbs, face and tongue (hatters' shakes), and that other diseases among fur workers are bronchitis, asthma, tuberculosis, skin diseases, loss of finger nails, blueness of hands, etc., it would seem that the animals whose pelts are used are not the only ones to suffer in order that you may wear a felt hat and a fur-lined coat.

A House with a Sail

THE sail on the little shack pictured is not for the purpose of propulsion. It is used as an awning so that the sun will not make the contents too warm. The hut belongs to a fisherman, who catches fish and crabs and sells them to the motor tourists between Los Angeles and Santa Barbara. The fisherman uses the sail when out in his boat, but when he gets back he removes the sail from his boat to his hut.

Simplifying the Inspection of Farm Produce



Each sack of vegetables or fruit can be dumped in the device, examined and re-sacked, all in a few seconds

DEALINGS in such commodities as fresh fruits and vegetables are peculiarly unintelligent. There is but the roughest approach to uniformity in standards of quality. Neither the buyer nor the seller knows accurately the quality of the goods bought and sold. To better this condition a device has recently been invented which is here illustrated.

Ordinarily such goods as potatoes are delivered to the buyer in a truck-load of bags. The buyer's inspector makes a rudimentary inspection. Because the bags are so tightly packed together on a

The device was invented and patented by a New York food inspector who wanted to see the whole consignment, not one or two selected sacks only

truck, only one or two from the tail end can be dropped off at a time. A bag is stood up and the string is cut; the bag is thrown over, and its contents are spilled out by lifting the lower end. As the average bag of potatoes weighs about one hundred seventy-five pounds, this entails considerable manual labor and time. After the inspector passes on the potatoes they must be shoveled up and thrown back into the bag and the bag must be sewed up. This process must be repeated for all inspected bags. If as many as five are inspected out of, say, one hundred on a truck load, the inspection is considered adequate. It frequently happens that when the potatoes reach their consumption destination a large proportion are found of inferior quality; they have never been seen by the inspector. Knowing that only the bags at the tail end of the truck can be inspected, the seller places there those of the best quality.

The device illustrated is intended to afford opportunity for better inspection and for the inspection of a larger proportion of the goods and the reduction of time and labor. The device is wheeled up to the end of the truck, a bag of potatoes is placed upon the small dumper and the string cut; it is then tilted over so that its contents spill and spread out in the tray. The inspector, standing upon the platform at the side, views the entire contents at a glance, and then pulls the lever. The weight of the potatoes in the tray causes the front end to descend; the potatoes run out through the spout into the bag held under it, and the bag is sewed up. There is little or no manual labor. The process is much faster than the old-fashioned way, and as many bags of potatoes throughout a delivery may be inspected as may seem desirable.

This device is suitable for inspection of the coarser vegetables—such as potatoes, carrots, cabbage, onions, turnips, parsnips and the like. It is also suitable for such fruits as lemons, oranges, apples and pears which need not be carefully handled.

The floor of the machine is constructed of slats, so as to allow the dirt to fall between them. Hence the buyer pays only for the goods bought. These slats can be fastened at varying distances so as to act as a sorting device for size. Undersized fruits or vegetables drop through and are discarded.

By means of a small tray fitted into the permanent one and having a solid floor, grains can also be inspected—such as oats and corn. Thus the entire contents of a bag can be properly inspected, instead of simply a handful.

The device described was invented by Hugh M. Foster, examining inspector of purchase and supplies for New York's Board of Estimate and Apportionment. After years' experience he became impressed with the lax methods in use. By law an employee of the city is prevented from profiting directly or indirectly by the sale of an article to the city government; therefore the inventor gave permission to the city to construct as many of these machines as would be needed for its own use. This permission has been accepted by the Board of Estimate and Apportionment on behalf of the city, and the machine has been constructed and is now being used in the institutional departments which buy such supplies.

Why Do Moving Pictures Seem So Life-Like?

It takes a certain amount of time to affect the eye. You do not see things instantaneously. If you move a lighted cigar in a dark room very rapidly you see what is apparently a continuous curve of light.

The motion-pictures reproduce movements faithfully for the same reason. Before the eye has a chance to see a picture in its entirety a new picture is flashed on the screen. The pictures appear and vanish at the rate of sixteen a second, in other words, so rapidly that the effect of continuous motion is produced.

Advantage is taken of this to produce very curious and unnatural effects; for example, an old building tearing itself down, a hole digging itself in the ground, a skyscraper growing up from a foundation without the aid of human hands. The camera operator has simply taken a picture of the demolition of the old building and the construction of the skyscraper at the rate of perhaps one an hour, but projects them all in twenty minutes.

Recruiting Britain's Army with Motor-Trucks, Motion-Pictures, Mirrors and Brass Bands

ALTHOUGH the British Army in the field at the present time is estimated at between one and two million, the regiments are located on so many fronts and fighting under such adverse conditions that the wastage of life is simply appalling. The problem of the British has been to fill the gaps caused by this wastage. Extraordinary measures have been taken to drive home the necessity of enlisting.

First, Lord Kitchener tried his hand at recruiting and then Lord Derby. What success Derby achieved has been due to very aggressive methods. He shrank from nothing. Thus a fleet of motor-trucks was employed as portable recruiting stations. They journeyed from town to town on the principle that if the men would not come to the recruiting stations, the recruiting stations would have to go to the men.

These trucks traveled over prescribed routes in England, Scotland and Ireland, going even to the remotest hamlets and villages where there was any likelihood of procuring a few able-bodied soldiers for the king. The first unit of this modern motor caravan to be put into service is shown in front of the Dublin Town Hall in the accompanying illustration. When in Dublin the truck was accompanied from section to section by no less than three complete military bands of music to help create recruiting interest.

Instead of asking recruits to come to his office, Lord Derby sent recruiting stations to them in the form of elaborately equipped motor-buses. Thus Dublin was canvassed with the vehicle shown. Orators appealed to Irish patriotism from the top of the vehicle and a military band supplied musical enthusiasm

One of the street mirrors used in London to shame reluctant cockneys into fighting for their country

The truck equipment also included a motion-picture outfit, which was used at the night meetings to show actual war scenes at the front as arguments why more men should enlist.

It was under Lord Derby's direction that lackadaisical English city-dwellers were spurred into taking a more active interest in their country's dire need by mirrors. Every Englishman was given an opportunity of seeing the man his country wanted.

Exposing the Tricks of the Short-Weight Tradesman

THE efficient management of the modern household is greatly promoted by the careful use of well-selected measuring appliances. Improved systems have been slowly evolved from the guesswork of earlier times. For example, terms like the "pinch of salt," "speck of pepper," "handful of rice," "sweeten to taste" (units of vague magnitude) have gradually been replaced by definite amounts, specified and measured. The Bureau of Standards has devoted much attention to this subject, so neglected in the average kitchen. Household appliances ought to include:

1. A test set of weights and measures for checking purchases and other purposes.

2. Meters for measuring the delivery, for household use, of gas, water and electricity.

3. Special measuring instruments, such as thermometers, hygrometers, barometers, hydrometers and time pieces, for measuring temperature, moisture, pressure, density and time.

4. Special measures used in cooking.

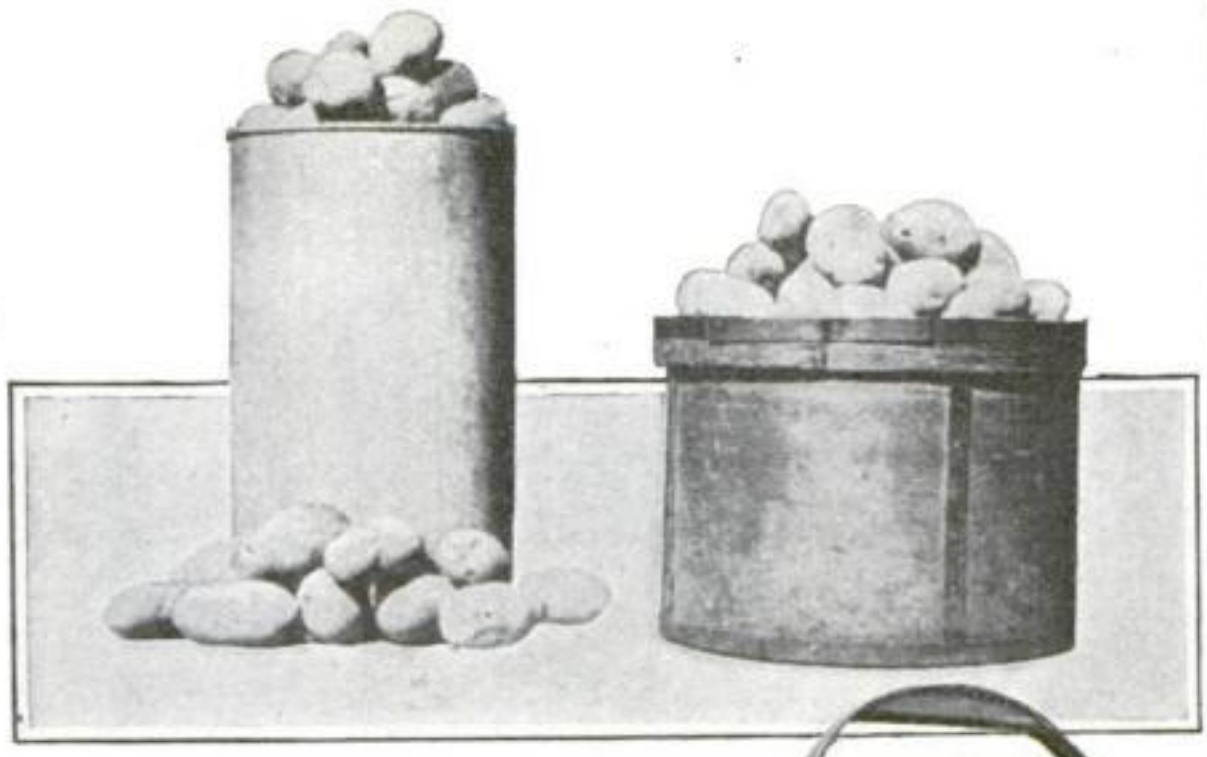
The housewife's safeguards—accurate measures. These are glass graduates, pints and half pints, and accurate spoons, from table to quarter teaspoons

The basis of the kitchen system of weights and measures is the standard cup. Ordinary china cups cannot be used, since they vary in size. A special set of spoons will also be found convenient.

Accuracy in measurement should not be confined to baking and cooking, but should also extend to buying. In this regard, it is a fact that many housewives scrutinize the cost and quality of goods, but fail to realize that unless the quantity is determined, the actual cost price is not ascertained. Dishonest merchants, whose prices are low, may be making big profits by giving short measure.

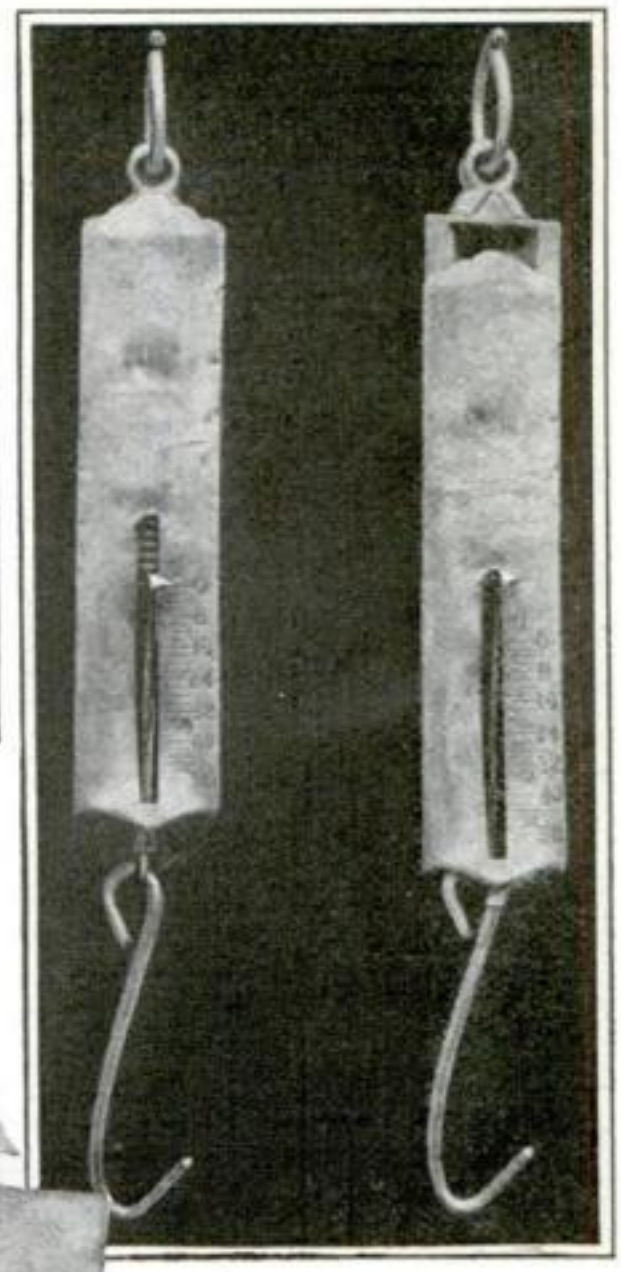
A "crab" or "handcuff" scale. By combining its parts incorrectly, results greatly in error are obtained, the commonest method resulting in shortages of 25 per cent

The Bureau of Standards discovered that only a few states and a few of the larger cities maintained any efficient inspection service, and that negligence in this regard was costing the consuming public large sums of money, and putting a premium on dishonesty in competition. Shortage in weights and measures was found to be common. The honest dealer, as well as the purchaser, suffers from the existence of such fraud, since the possessor of a lying scale can apparently undersell him



These two measures have the same capacity, but the tall measure, which has no bottom, has so small a diameter that a proper heap cannot be obtained. Note the overflow

The purchaser of gasoline sees only the five-gallon measure, but the three-gallon measure inside is the one really filled

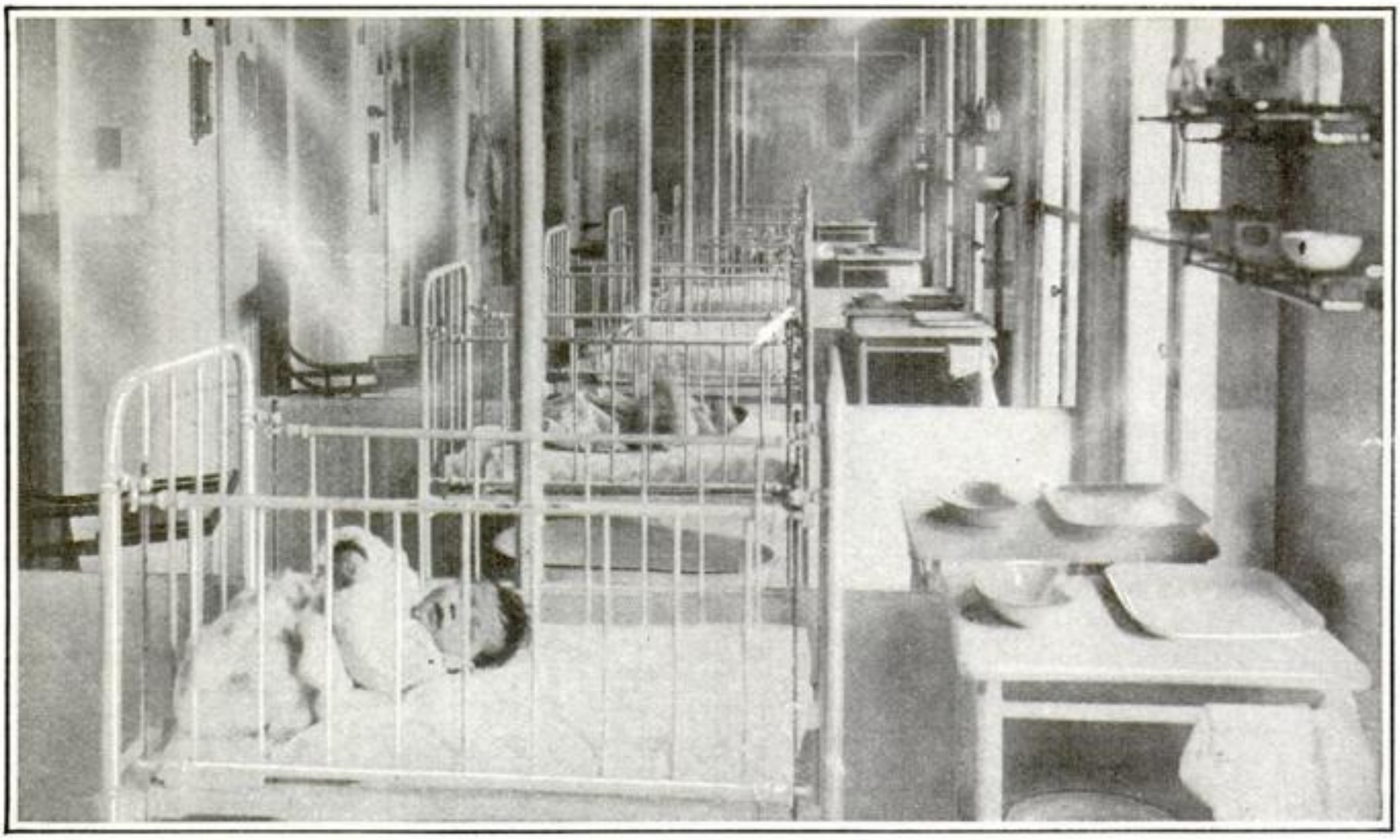


This straight-face spring scale has a fraudulent sliding face. The left one is used in buying. The seller slides the face downward, as on the right, thus greatly decreasing the indicated weight and defrauding the unsuspecting buyer

and yet actually receive more for his goods. As an example, it was estimated that the consumers of the country lost annually more than eight millions on short-weight deliveries of one staple article of food.

The methods of cheating and the types of false apparatus exhibit great variety. Among the different types of false capacity measures may be mentioned those having movable or false bottoms; measures having a portion of the height cut away from either the top or bottom; measures with staves removed and the hoops and bottom adjusted accordingly; "bottomless" measures which have relatively small diameters and high sides, and which—although they may contain the proper number of cubic inches—give incorrect quantities, as they do not permit a proper heap; measures with false interiors, such as have been found in milk cans and measures for selling gasoline; and liquid measures used for dry commodities. This last expedient is in use to some extent in practically all parts of the country and results in a shortage of about fourteen per cent. It is one of those practices which has come into use largely through "trade custom."

The use of correct measuring scales of high quality is not always in itself a guarantee that correct amounts will be given, for it is possible for the user of correct scales to manipulate them to his advantage. A type of scale, which was formerly common among certain classes of dealers, is the straight-face scale, designed to be held in the hand, with the graduated face made movable, so that the dealer might lower or raise it so as to make the pointer indicate an amount less or greater than the true weight, according to whether he was buying or selling. Many other forms of false scales have been used for years.



A large hospital for infants has recently been equipped with a number of rooms with glass walls, so that without entering the rooms nurses may observe the babies as easily as if they were so many fish in an aquarium

Babies in Glass Cases

TWO years ago the Hebrew Infant Asylum at Kingsbridge Road and University Avenue, New York, adopted the plan of using glass cases for babies admitted to the observation building. As a result the children may be observed without the necessity of entering their rooms.

Each child is supplied with its own utensils, towels, bath, etc. If one baby develops a communicable disease it is impossible for it to give it to another. This is the first building of this kind to be erected in the United States. The idea was taken from some European institutions and adapted to the needs of this asylum. There are glass chambers enough to accommodate twelve babies ranging in age from a few days up to one and a half years.

Why Is the Sun Hot?

IF we could build up a solid column of ice from the earth to the sun, two miles and a half in diameter, spanning the intervening distance of ninety-three million miles, and if the sun should concentrate his entire power upon it, it would dissolve in a single second, according to a calculation made by Professor Young. To produce this enormous amount of heat would require the hourly burning of a layer of anthracite coal more than nineteen feet thick over the entire surface of the sun. If the sun were composed of solid coal and we derived our heat from the burning of that coal the sun would burn out in less than five thousand years. Since the earth is millions of years old the sun can not be burning. Its heat must be generated in some more persistent way.

The great German physicist Helmholtz was the first to explain satisfactorily what keeps the sun hot. The sun is not burning; it is heated to the glowing point, like a piece of white hot iron. Helmholtz found that if we suppose the sun to be contracting by only two hundred and fifty feet a year we would receive our present amount of heat. In other words heat is being literally squeezed out of the sun. Professor Newcomb estimated that when the squeezing process has continued for about seven million years, the sun will be one half its present size.

A Dollar Made of Corn

A REMARKABLE reproduction of a silver dollar was recently made by George Herren, a cabinet maker of Pella, Iowa. This reproduction which is thirty-two times the size of its model, is constructed entirely of kernels of corn, glued to a backing of heavy pasteboard.

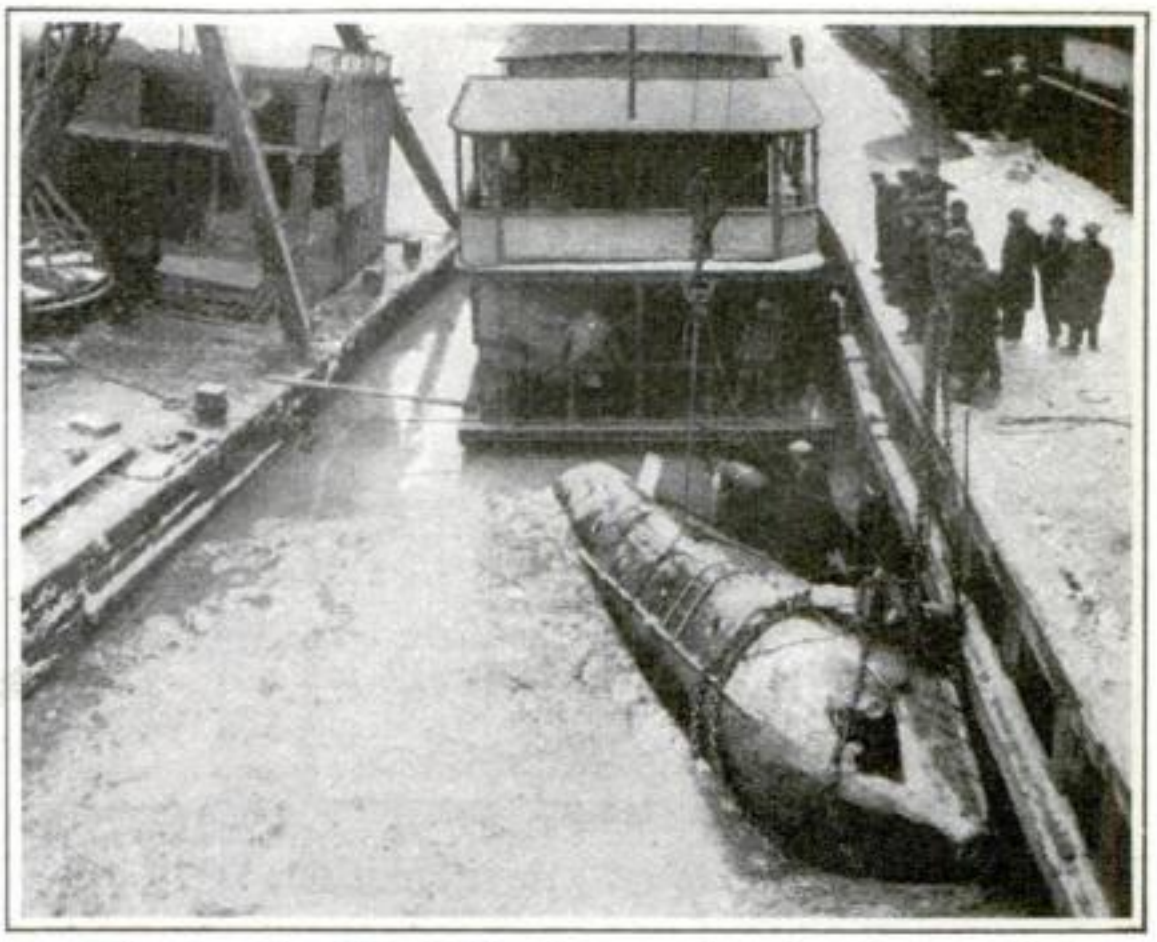
As shown in the illustration, the resemblance is very close. It is estimated that over a quarter of a million kernels of corn were used, and its construction occupied the maker's time for more than six months. More than thirty different shades of color are to be found in the "dollar," which is to be found on exhibition in the home of the patient cabinet maker.

The Lady on the Dollar appeared on a giant disk of corn kernels after George Herren had spent many winter evenings on his mosaic

A CHURCH, claimed to be the smallest in America, was recently dedicated in Manchester, N. H. The main auditorium is eighteen by twenty-eight feet, with seats for about seventy persons. In a tiny gallery are seats for twenty-eight. There is also a vestry and a basement.

A Submarine That Dived But Once

TWENTY years ago an aspiring inventor in Chicago designed and built a submarine which he claimed would revolutionize the construction of underwater craft. The public, being somewhat skeptical, christened the marvel "Foolkiller Number One," and turned out in large numbers to see its trial trip in the Chicago River.

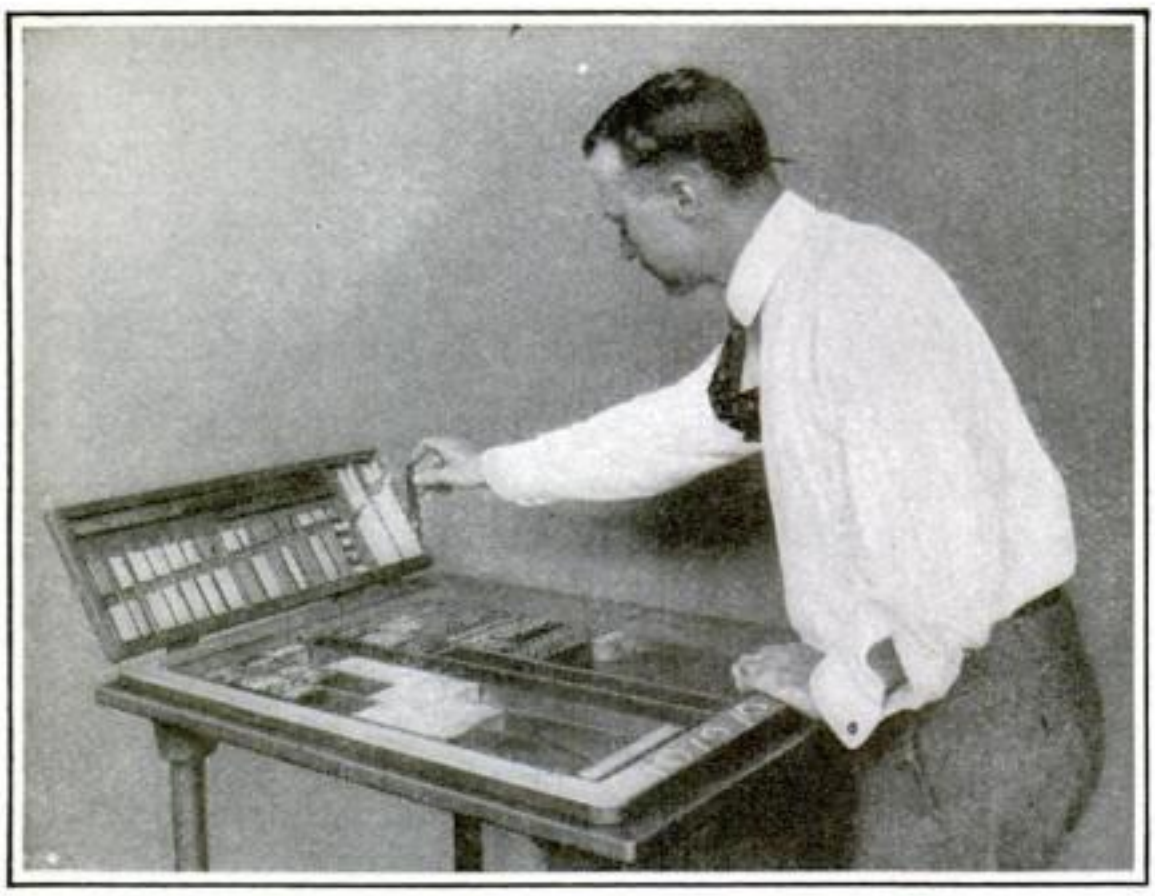


This is the "Foolkiller," a submarine boat which Chicago watched disappear twenty years ago, and saw reappear only a few weeks ago for the first time since it was "tested" so disastrously

Its ability to dive was at once demonstrated, for the new boat immediately submerged, and appeared no more. A few months ago, the ill-fated craft was raised to the surface after several unsuccessful efforts had been made to drag it out of the river mud. It is said that the "Foolkiller" will be placed on exhibition on dry land, as it is feared that its natural ability for submerging will be demonstrated again if the ship is left in the water.

IN New York City, one person is injured by a motor vehicle every seventy-five minutes. One victim out of every twenty dies.

THE bones of all flying birds are hollow, thus combining the greatest strength with the least weight.



The type furniture awaits the make-up man in a rack attached to the "turtle" table

A Motion-Saving Rule-Case for Printers

HERE is pictured a little invention, just out, which will be appreciated by every printer. It is a time saver in newspaper offices, and a saver of many steps to all those who make up type into the forms.

This is a new style of rule case for printers to be connected with the form chase within easy reach of the make-up man who has occasion to use the many-sized rules required in making up his page of type matter.

Heretofore the make-up man had his rules somewhere in a separate case near at hand but never within easy reach, so that whenever he wanted a certain-sized rule it was necessary for him to go to the case and get it.

With this new invention, all the different-sized rules are right at the page he is making up, and all he has to do is to reach over the page and pick out just the kind of rule he needs without even changing his position over the type.

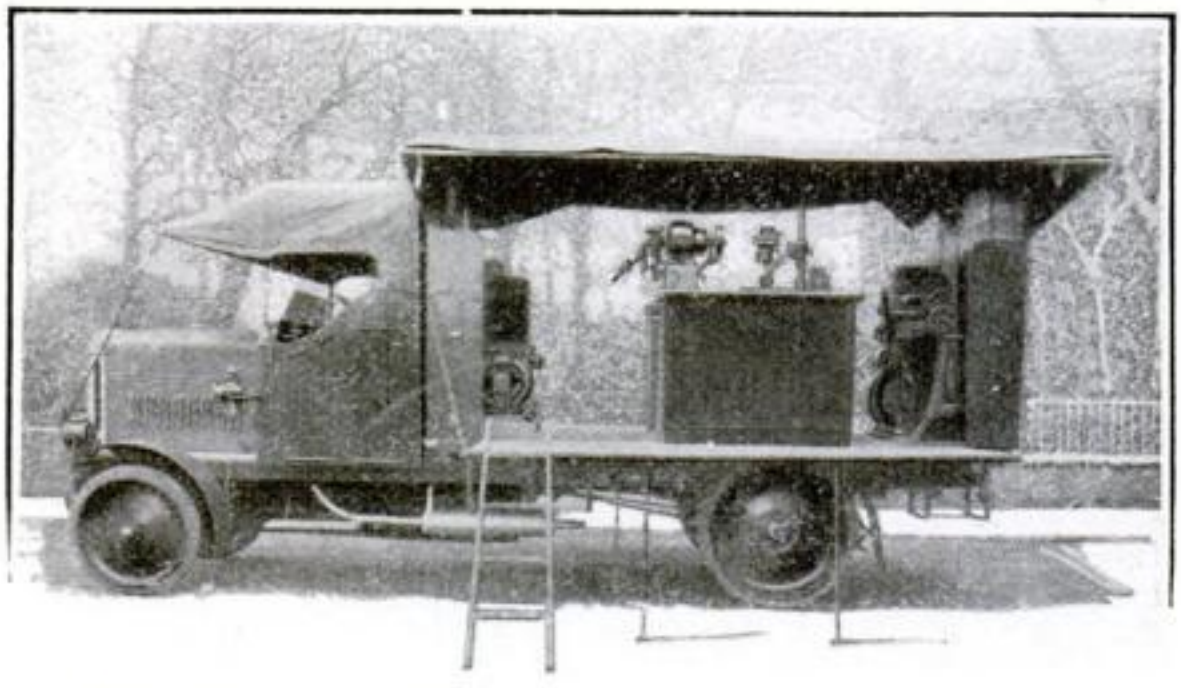
The case of rules extends over the end-screws in the chase, and when the page is made up and ready to lock, the case is lifted off the end screws and hooked on to the next page to be made up. The invention is being used in the make-up room of one of Cincinnati's largest newspapers.

An Automobile Machine-Shop for the Battlefield

BECAUSE of the great number of automobiles and aeroplanes which are being used by the armies in the field in Europe, it has been found necessary to provide a practical traveling workshop which may be hurried to any point along the road where a breakdown has occurred.

One of the most complete of these workshops is shown in the accompanying illustration. Upon a powerful motor-truck is mounted an independent power unit, consisting of a dynamo, switchboard, and a charging-set. Two work benches are provided for the workmen who accompany the car, and these are equipped with a five-inch lathe, drills, grinders, and a complete set of tools.

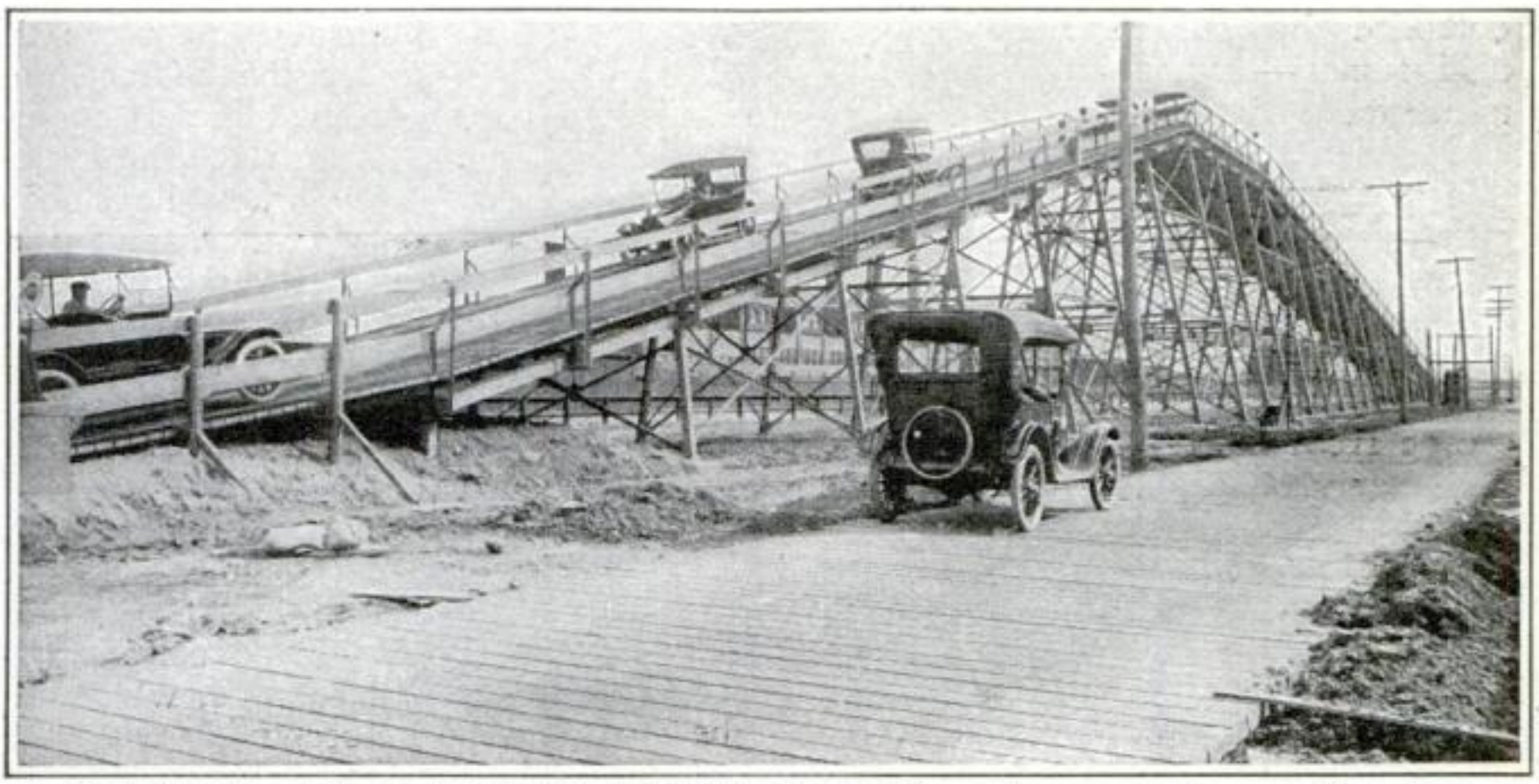
One of these traveling workshops will soon be attached to each column of the Royal Flying Corps and to the British Army Service Corps, in order that all repairs may be made at the front without the necessity of requisitioning aid from the service stations at the army headquarters.



Traveling automobile repair shops were a novelty at the automobile shows two years ago. To-day they are common necessities of war

A Steel Hill to Test Automobiles

THE ability of a motor car to climb a hill "on high" has long been considered a necessity by motorists and a selling argument by manufacturers. And because Detroit, where many motor cars come from, is in a flat section of the country where hills are the exception, one manufacturer has built the steel test-hill illustrated. Furthermore, this same manufacturer has also constructed a half-mile track for speed tests and what is termed a "sand pit."



Detroit automobile dealers had to build this steep hill to order so as to have grades where they could demonstrate the hill-climbing proclivities of their cars in that city of level highways

The track permits speed tests, and in the "sand pit" the testers alternately sink the cars to the hubs and then drive them out of the clinging sand.

But the test hill is perhaps the more remarkable. The hill is located in the center of the speed track and is built entirely of structural steel. It is five hundred and forty-two feet long and thirty feet wide. The two approaches have grades of varying steepness so that cars can be tested on gradual and steep inclines.

The speed track is built of wood, more than two hundred and fifteen thousand square feet of lumber being required. It is built on a foundation of clay and cinders with the turns banked and is surfaced with pine planking, creosoted to afford a dustless surface for the tests.

The Noisy Motor-Boat and the Unabashed Fish

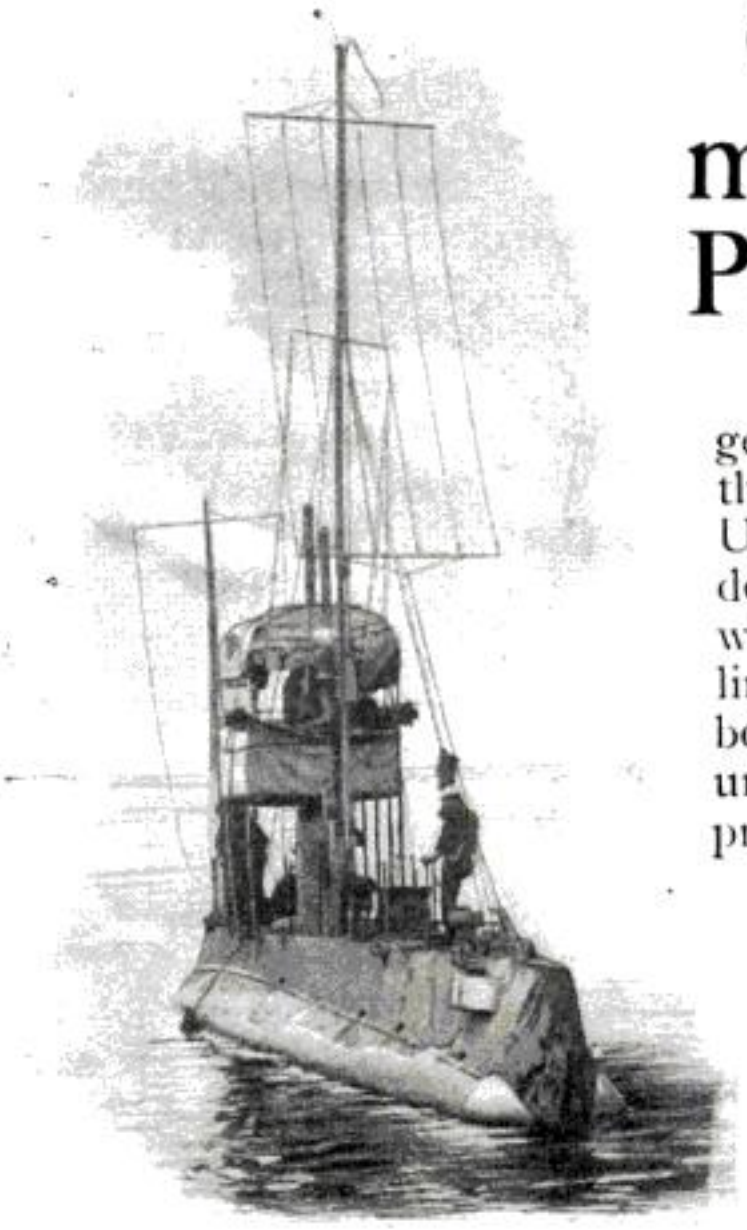
CONTRARY to general opinion, a number of motor-boats cruising about a harbor with more or less noisy engines have no appreciable effect upon the fish in nearby waters. It has long been thought, particularly by fishermen, that the presence of a noisy motor-boat would drive the fish away. Exhaustive experiments recently conducted by the Bureau of Fisheries prove this theory to be incorrect.

In testing the effect of motor-boat noises, on fish, a number of young scup, known to be sensitive to sounds, were placed in a large wooden cage. This cage was fastened in quiet water at the end of a wharf, and a motor-boat with a very noisy engine was run at varying distances past the cage. At no time did the fishes appear to be disturbed by the noise, except when the splash from the boat hit the cage. Then the scup would generally dive to the bottom of the receptacle.

Another test was made with baited lines. When a number of fish had commenced to nibble at the bait, a motor-boat was backed up under its own power until its stern was directly over the lines. The fish continued to nibble until driven off by the backwash from the propeller.

Can Battery Explosions

On Submarines Be Prevented?



The United States Submarine E-2, the latest victim of a naval accident which has been attributed to the explosion of battery gases

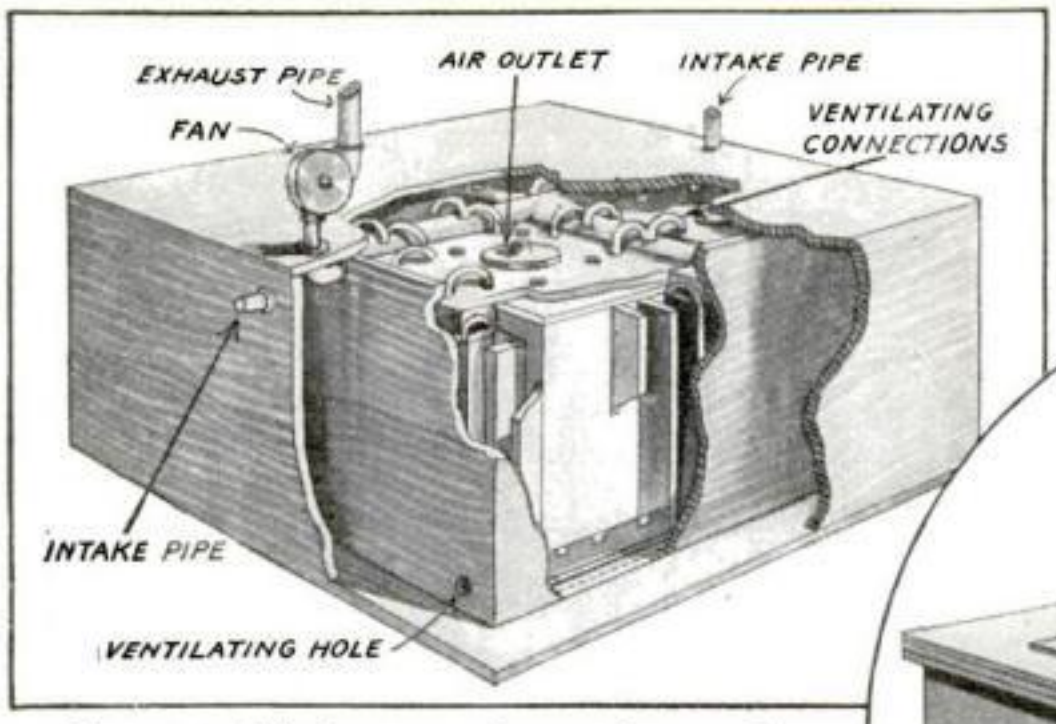
HARD upon the disaster which befell the F-4 off Honolulu—a disaster which resulted from a storage-battery lining and rivets being corroded by sulphuric acid fumes—comes an accident sustained by the E-2 which seems to be due to the explosion of gases generated by the storage battery. When lead-plate storage-batteries are employed, gases or fumes are likely to escape from the battery compartment and to suffocate the crew; the fumes (a fine spray containing dilute sulphuric acid in suspension) are very penetrating and eat into the machinery of the boat and parts of the hull, causing corrosion and destruction of the metal. At least one French submarine was lost as a result of this corrosion. In the Edison type of battery, which does not employ lead, hydrogen gas is generated, which when mixed with the proper volume of air, is highly explosive. Whether the old lead battery or the modern Edison battery is installed, a ventilating system must be provided in order to remove the gases. From the very first, then, we find that submarine designers have bent their minds to the installation of blowers and ducts which will suck out the dangerous gases and conduct them to the outside of the vessel. The illustrations on the opposite page show very clearly the fundamental principles on which these ventilating systems are based.

But, after all, this is a makeshift. The storage battery is inherently dangerous. Recognizing this, the Navy Department has for over a year been at work trying to do away with storage batteries altogether. It seems likely that before long the United States Navy will develop a submarine in which the same propelling engine will serve both at the surface and under the surface. At present Diesel engines drive the vessel when she is above water, and electric motors deriving their current from storage batteries, are employed for underwater propulsion.

While nothing definite is as yet known about the Navy's experiments, it is certain that compressed air will be used, which will be stored in tanks occupying the space now taken up by the batteries. The air will not only serve to feed the engines but also to provide a purer atmosphere for the crew. It seems certain that with the compressed air system the radius of the submarine will be increased. Why? Because the electric motors for underwater propulsion will be dispensed with and their place taken by compressed air tanks. In other words, the space formerly occupied by storage batteries and by electric propelling machinery is to be taken up by compressed air tanks, representing so much stored power.

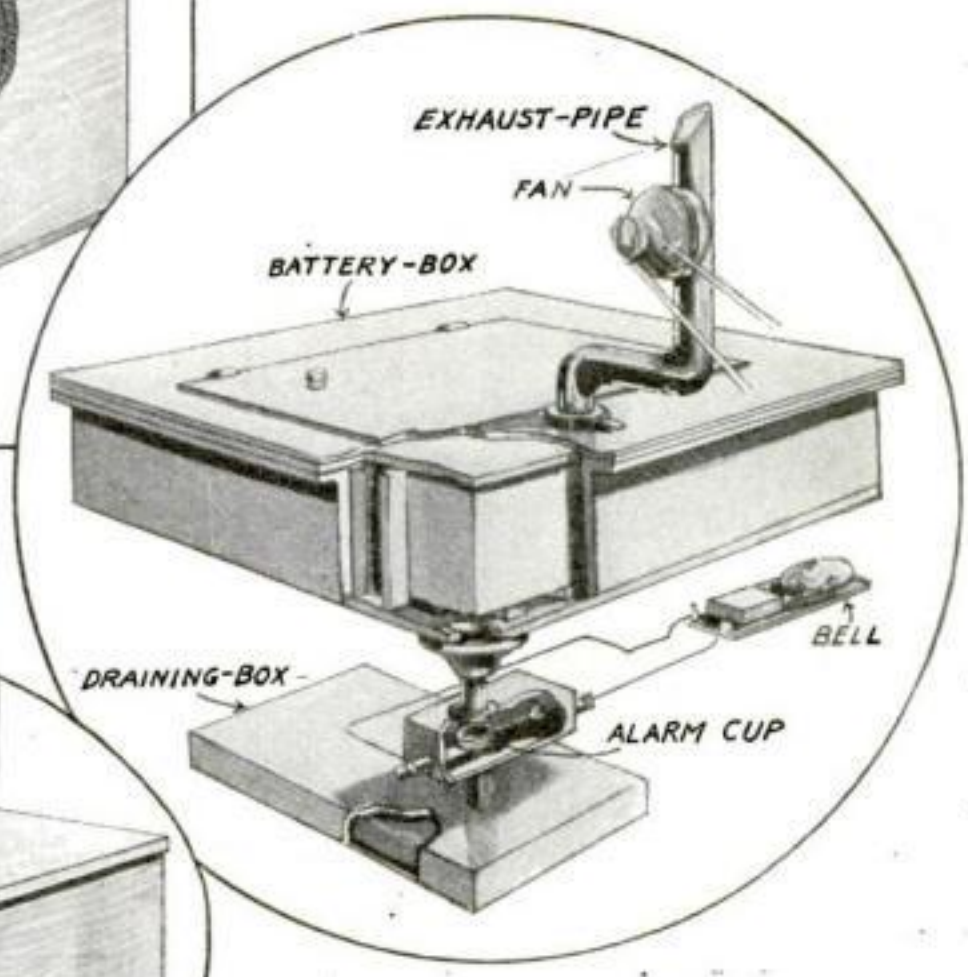
As soon as the submarine reaches the surface it will suck air in automatically through its pumps. In other words it will breathe when it reaches the surface just as if it were a mechanical whale.

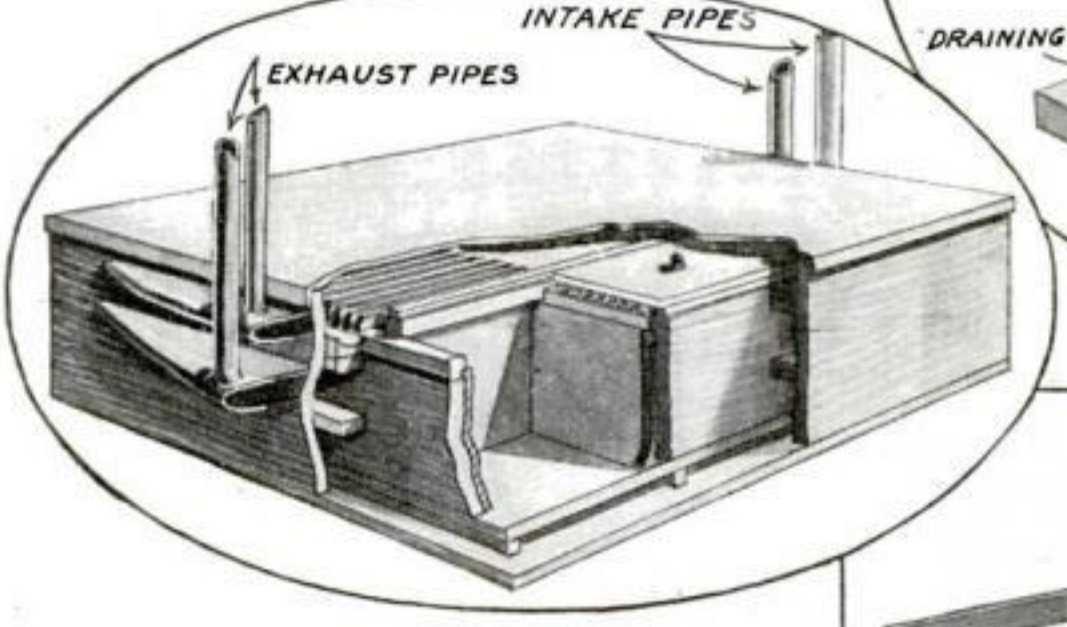
The United States Navy has been freer from terrible submarine accidents than that of any first-class power. But even the two accidents which American submarines have had are two too many.



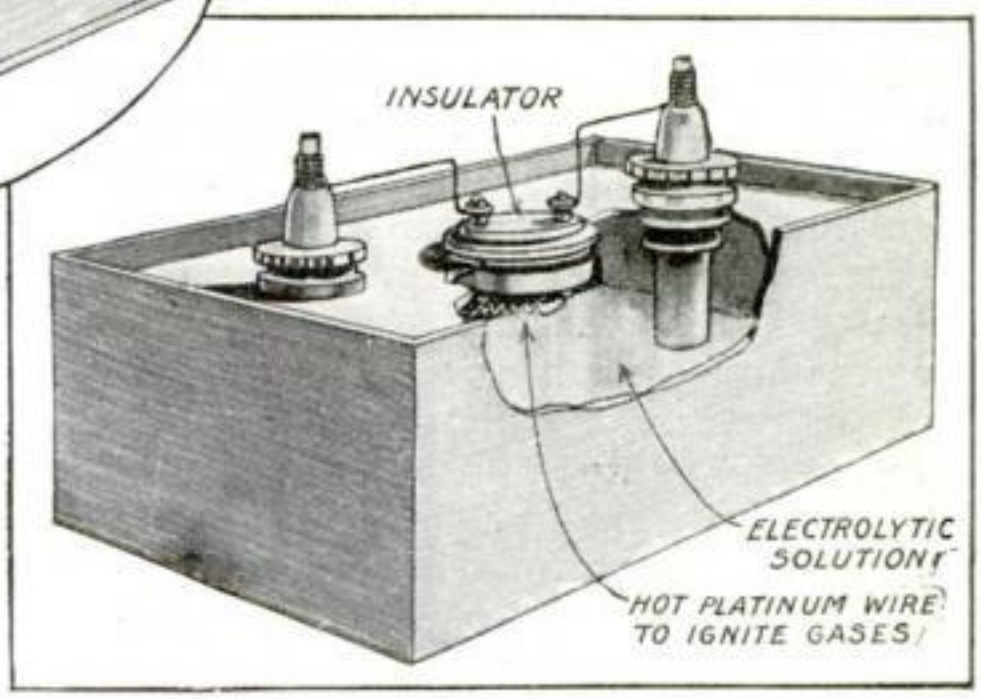
Above and below are shown the usual methods of ventilating. One cell is insulated from another

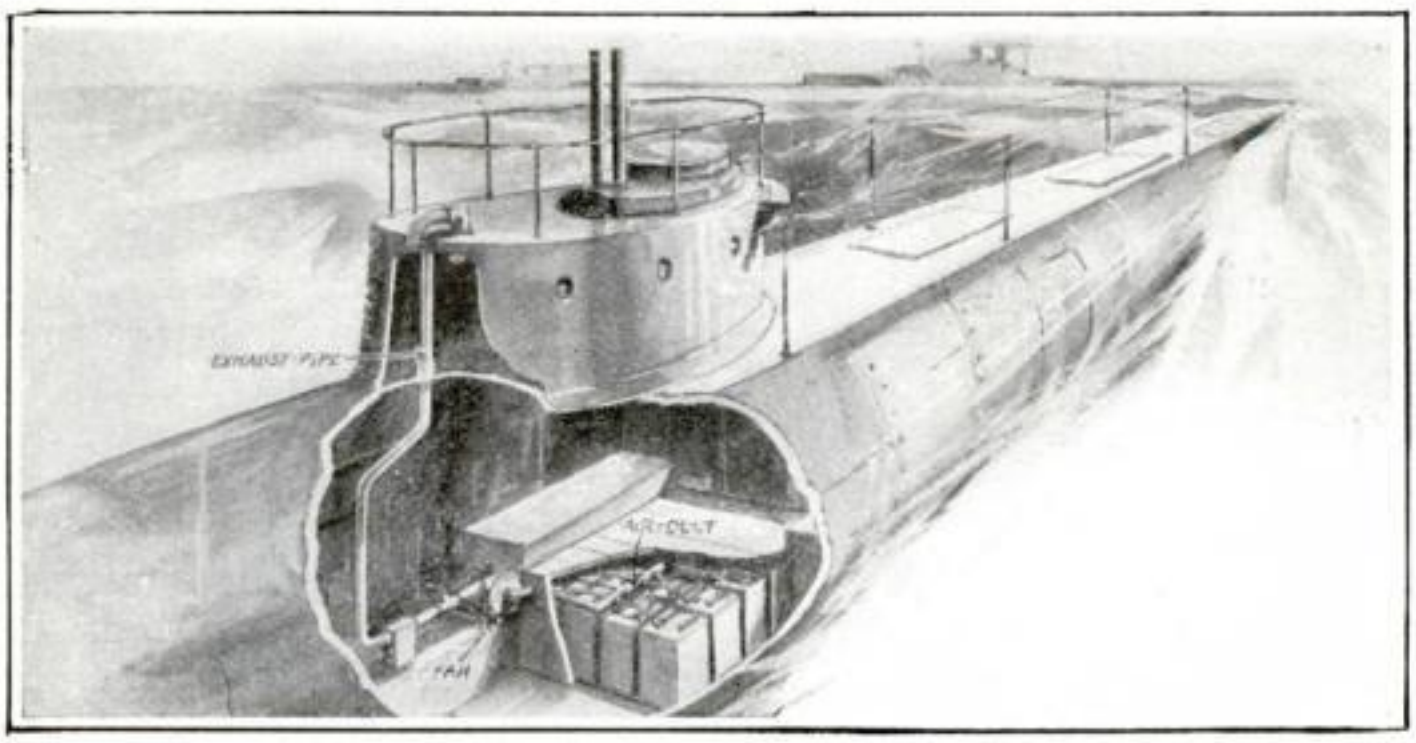
The method of ventilating batteries shown below was patented by the builders of the Holland boats. An alarm rings when a jar has been broken. An insulated tank collects the leakage





Edison patented the method on the right of coping with the hydrogen and oxygen gases of his battery. These form an explosive mixture, which is ignited by a red-hot wire. As Edison says "By my process I cause the combination of the oxygen and hydrogen to take place at shorter intervals before the quantity of the gases evolved have become sufficient to render explosion dangerous"

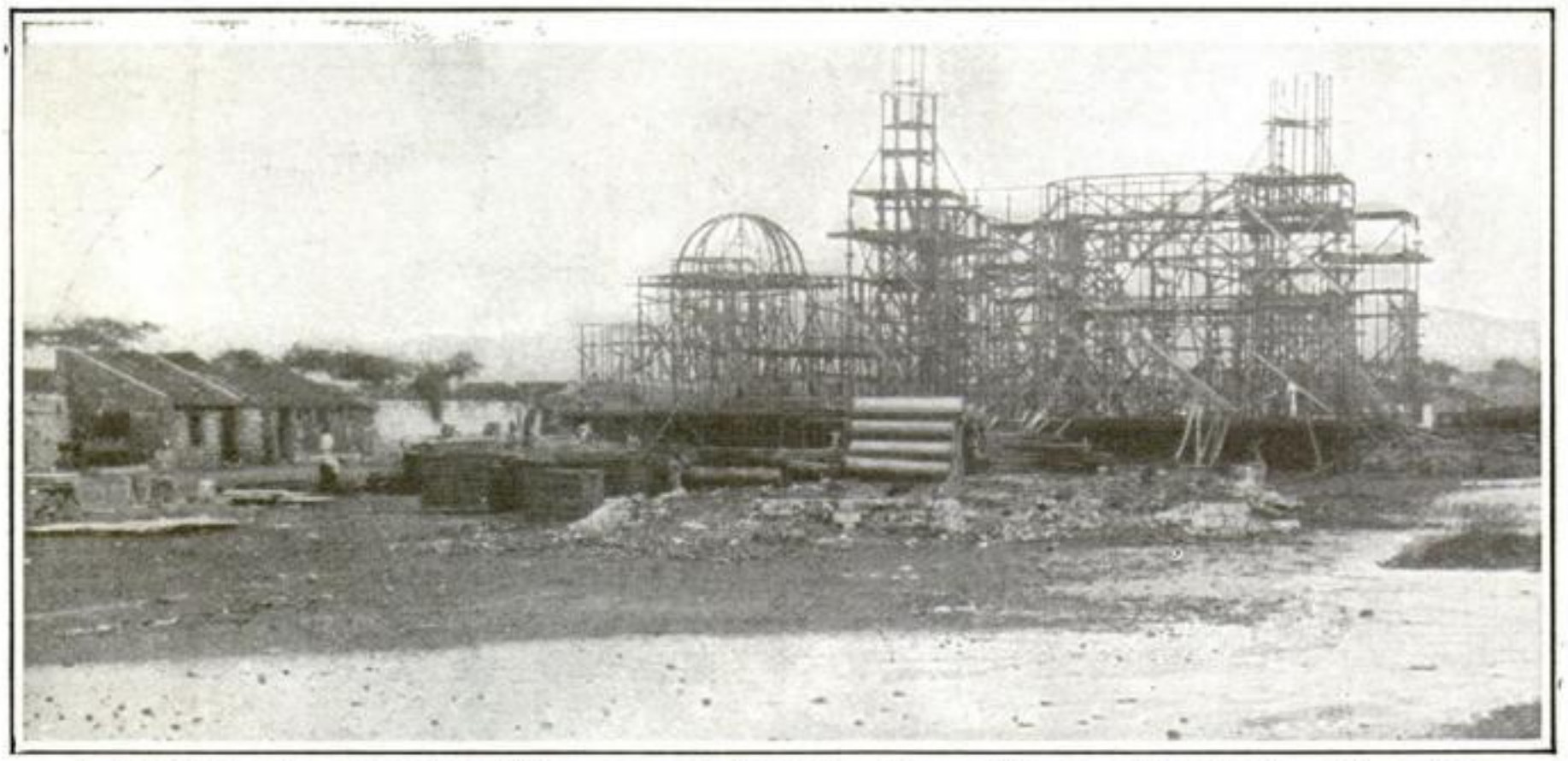




To the left, Simon Lake's way of ventilating storage batteries. An air-duct extends through the battery compartment. It is connected with a suction fan discharging into a pipe, leading through the top of the hull. A non-return exhaust-valve prevents water from reaching the air-duct and cells

Capturing Jamaica for a Film Play

By George F. Wörts



A Moorish city, covering thirty acres of ground, with castles as well as huts, and costing thirty thousand dollars, is but part of the gigantic setting of the new film play

WHEN Annette Kellerman and her large company of players arrived in Jamaica one day last August with the intention of making a moving picture that would cost somewhere in the neighborhood of one million dollars, she found that the entire group of islands was under martial law. Jamaica was heavily garrisoned, all sorts of restrictions were placed upon strangers, and into this unfriendly atmosphere of British colonial red tape came an invading army of actors and actresses, cameramen, electricians, property men, scene painters, directors, and what not. Besides all these there were, of course, heavy artillery in cameras, and the ammunition to be fed to them, tons of chemicals, properties enough to stock the Metropolitan Opera House for a Wagnerian season, and just for good measure an entire menagerie, consisting of lions, tigers, elephants, camels and other creatures calculated to lend Oriental atmosphere when the right time arrived.

Whether or not the estimated cost of one million dollars has undergone the usual press agent's expansion, the fact remains that the picture will be one of the most spectacular that has ever been produced in the whole history of films.

A fair idea of the amount of materials required for the stage settings, costumings, handling of films, etc., can be gained from the knowledge that five shiploads went down to Jamaica from New York the first time. The first consignment of actors, actresses and workmen alone amounted to twelve hundred persons. One thousand tons of properties and stage settings have been shipped.

To insure the proper attention to the cinematographic film, chemical laboratories, storehouses and printing and developing plants have been constructed. An ice plant for chilling the tropical water used in development was erected.

One of the first tasks to which the director in charge, Herbert Brennon, set himself was the construction of the largest stage that has ever been built. It measures over all five hundred by two hundred feet, and is being used for the erection of giant "sets" of all varieties. More than six different companies occupied with different scenes of the film can work at one time.

Probably the most cumbersome task is the construction of an inland Moorish city which covers thirty acres of ground. Contrasted to the usual flimsy structures

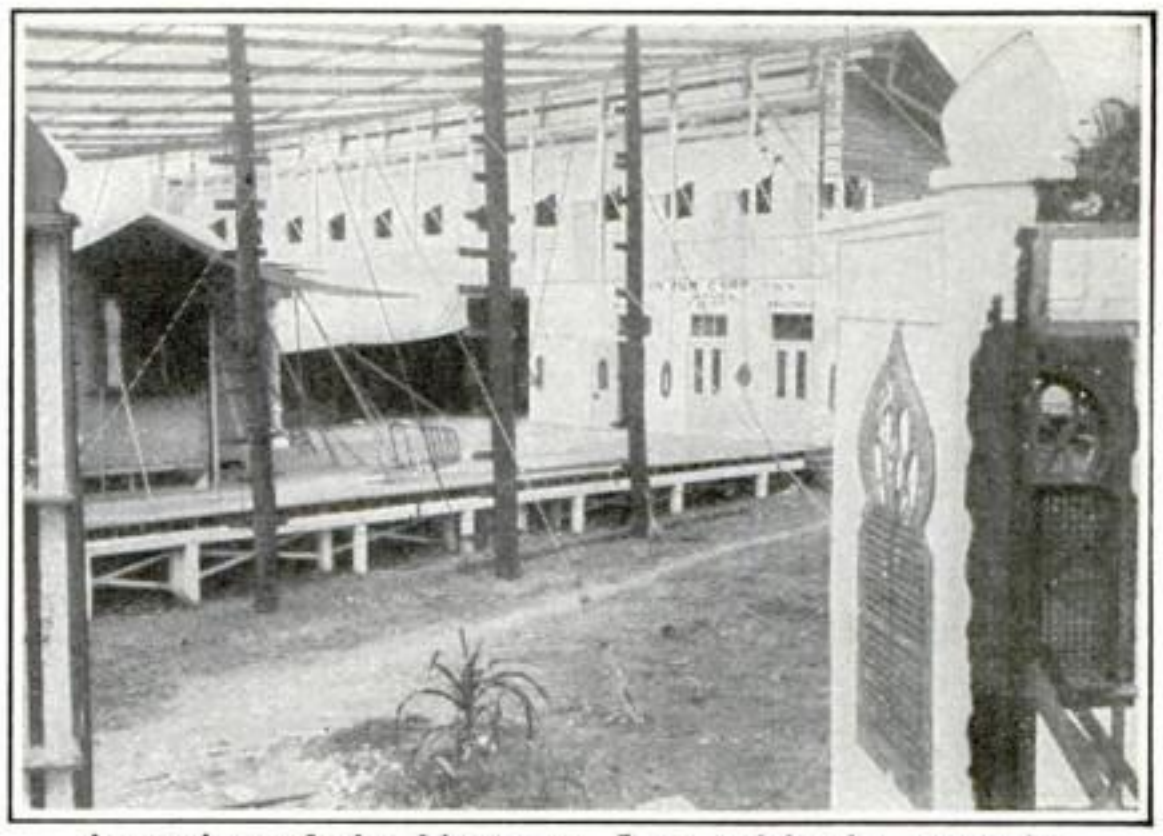
used, it was necessary that these buildings be made of durable materials, owing to the destructiveness of the West Indian hurricanes. Thirty thousand dollars is the estimated cost of this city.

Another important feature which will be unique in film history is the storming of the historic old fortress of Augusta. Before reconstruction of this aged ruin could be attempted, it was necessary to make the locality thoroughly sanitary. For putting the fort in presentable shape several boatloads of concrete, stone and steel—all of the stuff of which fortresses are made—were shipped down from New York. It has taken five months to complete the restoration.

Now that it has been rebuilt, Fort Augusta is to be destroyed and the task of destruction falls to the lot of the West Indian squadron of the British navy. Real powder and real shells will be employed. Needless to say, it required several weeks of persuasion before the permission to stage this battle could be obtained. Before this issue of POPULAR SCIENCE MONTHLY will have reached the newsstands, the West Indian fleet with decks stripped as in actual battle, with gun crews stripped to the waist, with range finders perched in the conning towers, will be bombarding the fortress—and Fort Augusta will have again crumbled into ruins.

Quite as interesting as the construction problems that have been involved is the number of players who will appear in the film. In addition to the twelve hundred actors and "mermaids," there are scheduled to appear ten thousand Hindus who have been held in Jamaica since the completion of the Panama canal, five thousand British cavalrymen and more than five thousand native Jamaicans who have been recruited for the various mob scenes.

The exact nature of the film has not yet been divulged, nor has a name been decided upon. A few of the facts that are known is that besides the bombardment of Fort Augusta, and the use of a Moorish city, there will be a number of mermaid scenes; Trinidad asphalt lake will figure; some of the scenes will take place in the heart of the jungle; and a submarined ship is included somewhere on the programme. Just how consistent the plot will be with all this array of the spectacular, is something for time and the audience to decide.



A section of the big stage floor, with the executive offices at one side. A portion of a Moorish house may be seen in the foreground

A Transfer Solution

PRINTED pictures from magazines, newspapers, folders, etc., may be transferred to paper, cloth, cardboard, glass or china with the following solution:

One bar of common soap is dissolved in a gallon of hot water, to which one-half pint of turpentine is added. After it has stood for a night, stir well and bottle. The solution is applied to the print with a soft brush or one's fingers, and the material to which it is to be transferred is placed upside down on it. The back of the material is then rubbed and the design is transferred.

A picture may be transferred to glass for the purpose of a lantern slide. In such a case the glass must be varnished with a perfectly transparent varnish before transferring; then proceed as before. Pictures are transferred to china in the same way.

The Cost of the Great War

A chain of double eagles extending forty-four thousand miles is the cost of the war to date

$12,100.68—The Cost of Killing a Man in War

By Herbert Francis

WHEN walking along the Ringstrasse in Vienna one day a few years ago, I found myself in the neighborhood of the Hofburg, the Imperial and Royal palace. It was one of the days when visitors were admitted to the "Treasury of the Imperial House of Austria," so I turned through the gate and having witnessed the impressive ceremony of the changing of the guard, paid my krone and marched in. Purchasing an official catalogue of the treasures, I looked at the display of royal insignia, crowns and swords, the sacred relics such as a nail from the true cross and a tooth reputed once to have rested in the jaw of John the Baptist, and the diamonds, emeralds, pearls and rubies included in the list. Of all that I saw, I was most impressed with a sentence in the introduction to the aforementioned catalogue. It read that in 1876 it had been "decreed that in the future the Hapsburg - Lorraine private treasure should only include those objects which were held to be essential as demonstrating the power and wealth of the reigning family."

This might do very well for the consumption of the ignorant peasant of the Austro-Hungarian empire, but I imagined what would be said of the taste of a democratic American family which should thus blatantly announce in opening its gallery of art objects and relics to the public that the collection had been made with the purpose of "demonstrating the power and wealth of the family."

Later I visited the royal palace in Berlin. My chief recollections are of the plaster imitations of curtains with which a number of apartments were bedecked, the great felt slippers with which every visitor was equipped in order to protect the polished wood floors, and the theatrical manner in which the Kaiser's gold plate was displayed in the throne room. The golden vessels reposed on a metal framework so designed as to give opportunity for the close examination of each piece. The whole was enclosed in a glass cabinet with mirrors at the back. As the visitors entered the room an attendant would open a small door in the wainscoting and throw an electric switch, lighting up the interior of the glass case with invisible globes. By means of these footlights it was possible to see clearly both the front and the back of the golden dishes. With truly Teutonic efficiency, the at-

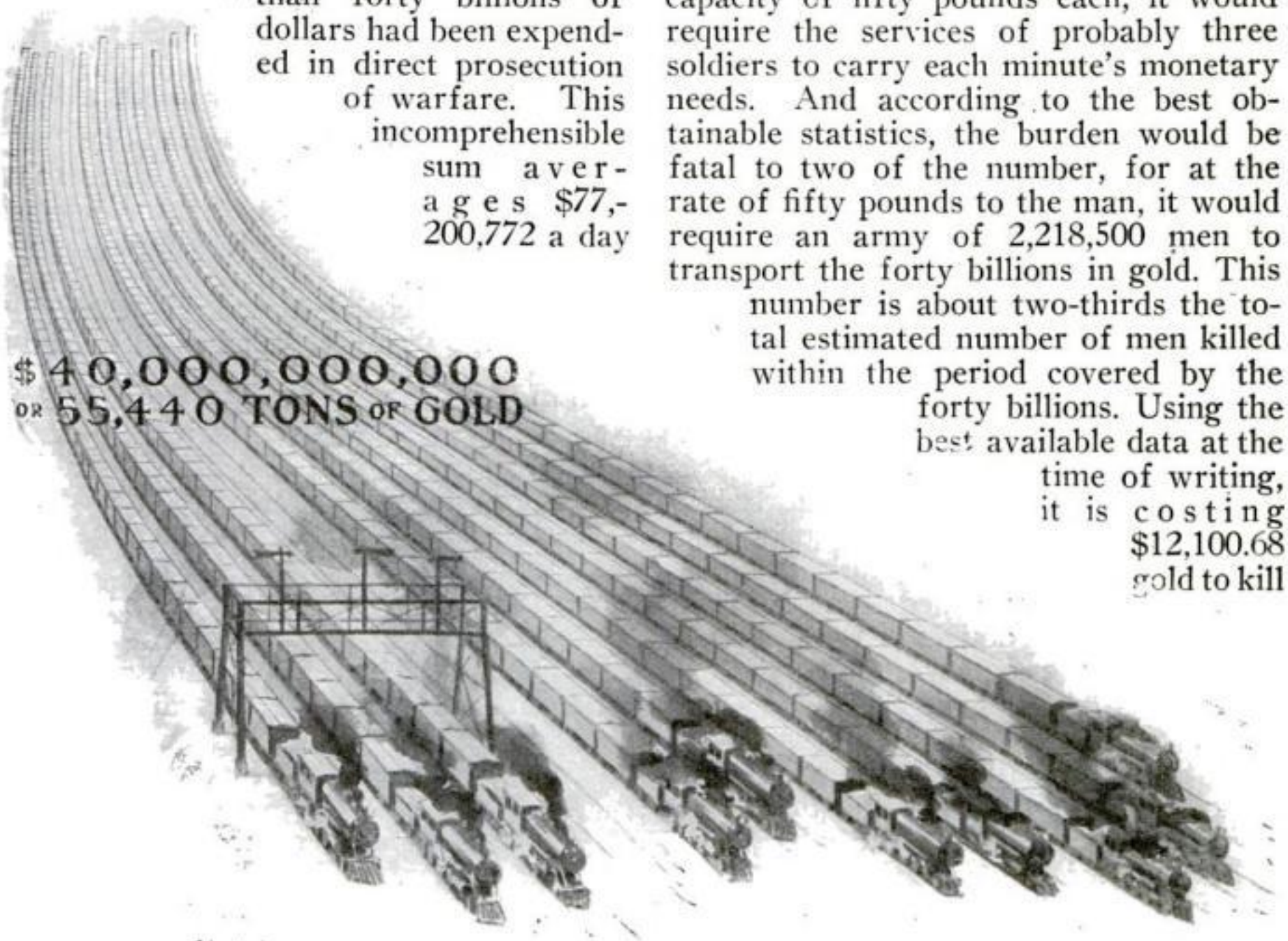
It costs over twelve thousand dollars to kill a man in this war

tendant cut off the current as soon as the visitors turned to leave the apartment.

I have described these two exhibitions by which the Teutonic rulers chose to demonstrate their wealth and power by way of showing how standards change. For more than a year now a method of demonstrating wealth and power has been exhibited in continental Europe which makes the old seem disgustingly cheap and picayune. All the jewels and gold plate in the palaces of Vienna and Berlin taken together would not foot the war bill for one day.

Three men would be required to carry the gold used to run the war for one minute

While exact figures showing the cost of the war will not be compiled until after it has come to a close, yet estimates have been made which show what a great destroyer of wealth it is. The best estimate is that up to January 1, not less than forty billions of dollars had been expended in direct prosecution of warfare. This incomprehensible sum averages $77,200,772 a day since war began and does not take into consideration the billions of dollars' worth of property wiped out in the countries invaded and through the deaths of millions of workers. For each minute of the day, the nations at war are obliged to pay out $53,611.64. Imagining this to be in gold and put into bags having a capacity of fifty pounds each, it would require the services of probably three soldiers to carry each minute's monetary needs. And according to the best obtainable statistics, the burden would be fatal to two of the number, for at the rate of fifty pounds to the man, it would require an army of 2,218,500 men to transport the forty billions in gold. This number is about two-thirds the total estimated number of men killed within the period covered by the forty billions. Using the best available data at the time of writing, it is costing $12,100.68 gold to kill



It would require fifteen trains of seventy cars each and one of fifty-seven cars to carry the gold spent in carrying on the war up to January 1, 1916

a man. War is a costly undertaking.

It was once even less efficient and more costly. In the Civil War, the number of Northern soldiers who died was 360,222, while the South lost, at the lowest estimate, 250,000. That war cost the North $6,189,929,908, while the South's bill was at least $3,000,000,000. It therefore cost approximately $15,059.97 to slaughter a man. Killing is done in a more wholesale fashion nowadays.

Fortunately, the warring nations are not obliged to gather together the forty billions and transport it at one time to the front. If they did, it would require fifteen trains of seventy cars each, and one of fifty-seven, each car being of the fifty-ton pattern used in hauling coal from the Pennsylvania mines to tidewater at New York harbor. This would interfere with the movement of food supplies, guns and other munitions of war for the time being. The weight of the gold would be 55,440 tons.

Even if it were desired to do this, there is not enough visible gold in the world to permit it. According to the figures of the director of the mint, the world's production of the precious metal between the years 1850 and 1913 inclusive, was $12,072,058,618, or less than one-third the estimated cost of the war. This, added to the $225,000,000 assumed to be in the hands of the potentates and other wealthy Europeans prior to the discovery of America, and the $3,383,224,000 figured to have been brought to view between the time Columbus first saw the Western Continent, and the discovery of gold in California, still leaves a deficit of nearly twenty-five billions to be made up otherwise.

But let us suppose there were forty billions of gold in the hands of mankind, and that through some gigantic financial operation it had reached America and been coined into double eagles. There would be, if the gold were alloyed with other metal to the usual degree of fineness, 2,222,222,220 of them, enough to cover the site of the Woolworth Building to a depth of seven feet eight inches, or form a pillar the height of the building, seven hundred and fifty feet, and twenty-two feet square. If placed on edge and face to face, they would form a roll 3,653.42 miles long. This roll would extend from New York to a point in the Pacific Ocean about six hundred miles west of San Francisco. Or, taking their diameter as one and five-sixteenths inches, they would pave a boulevard three hundred and fifty-one feet wide extending from one end to the island of Manhattan to the other a distance of thirteen miles. What a shining road that would be! The Irishman who expected to pick up dollars in the streets as soon as he landed, would literally be able to do it, assuming that the gold pieces were no better secured than is the surface of some of New York's thoroughfares. That great highway, broader than Broadway, would be the nearest approach to the streets of the New Jerusalem described by John, that the world could ever expect to see. And if all these gold pieces were laid flat in a single row, edge to edge, they would extend 43,841.12 miles around the waistcoat of the globe.

This would, indeed, be a "demonstration of power and wealth" that would make the display of jewels, relics and gold plate of the Teutonic ruling families look like a penny peep show.

A Mystifying Chemical Trick

A PLAIN blue handkerchief is shown to the audience. When the handkerchief is warmed it turns white and when heated resumes its former color.

Make a starch paste and add enough water to the paste to thin it. Then add sufficient tincture of iodine to color the liquid blue; a few drops will be enough. Dye a white handkerchief with this blue liquid and when the handkerchief is dry it is ready for the trick.

Raising a Motorcycle Stand Automatically

A MOTORCYCLIST may save the time and trouble of raising the stand when the machine is pushed off, by fastening one end of a door-spring to the stand near the bottom, and the other end to a convenient place on the luggage carrier. While the machine is on the stand, the spring is stretched, but the removal of the weight releases it, and the stand is pulled back into place.

What Makes an Electric Lamp-Bulb Glow?

WHEN you heat iron in a forge it becomes either red hot or white hot, depending on how hot it is. It sends forth light. The hotter it is the more light it gives. Finally there comes a point where the iron melts away.

The best light-giving material is that which will melt at the highest temperature. Carbon is a material which cannot be melted easily; but it burns up in the open air long before it reaches the melting point. Edison conceived the idea of making a little thread of carbon, of placing that thread in a bulb, and of heating it by the electric current to the highest possible point. In order to prevent the carbon filament from burning up he pumped out all the air in the bulb. The result was that the thread of carbon was heated to the glowing point, so that it gave a very bright light.

Tungsten is a metal which melts at the highest melting point. It ought to be the best light-producer, since it can be heated higher than any other metal without melting. The trouble is that tungsten is exceedingly brittle, so that a thread cannot easily be made of it. This difficulty was overcome about twelve years ago by making a paste of powdered tungsten and forming a thread of this paste. Later still a way was found of so treating the tungsten that it could be drawn into a hair-like thread a mile long if necessary. All modern electric incandescent lamps have such tungsten filaments. They consume very much less current than the older carbon-filament lamps and give a much whiter light, simply because tungsten can be heated so very much before it melts.

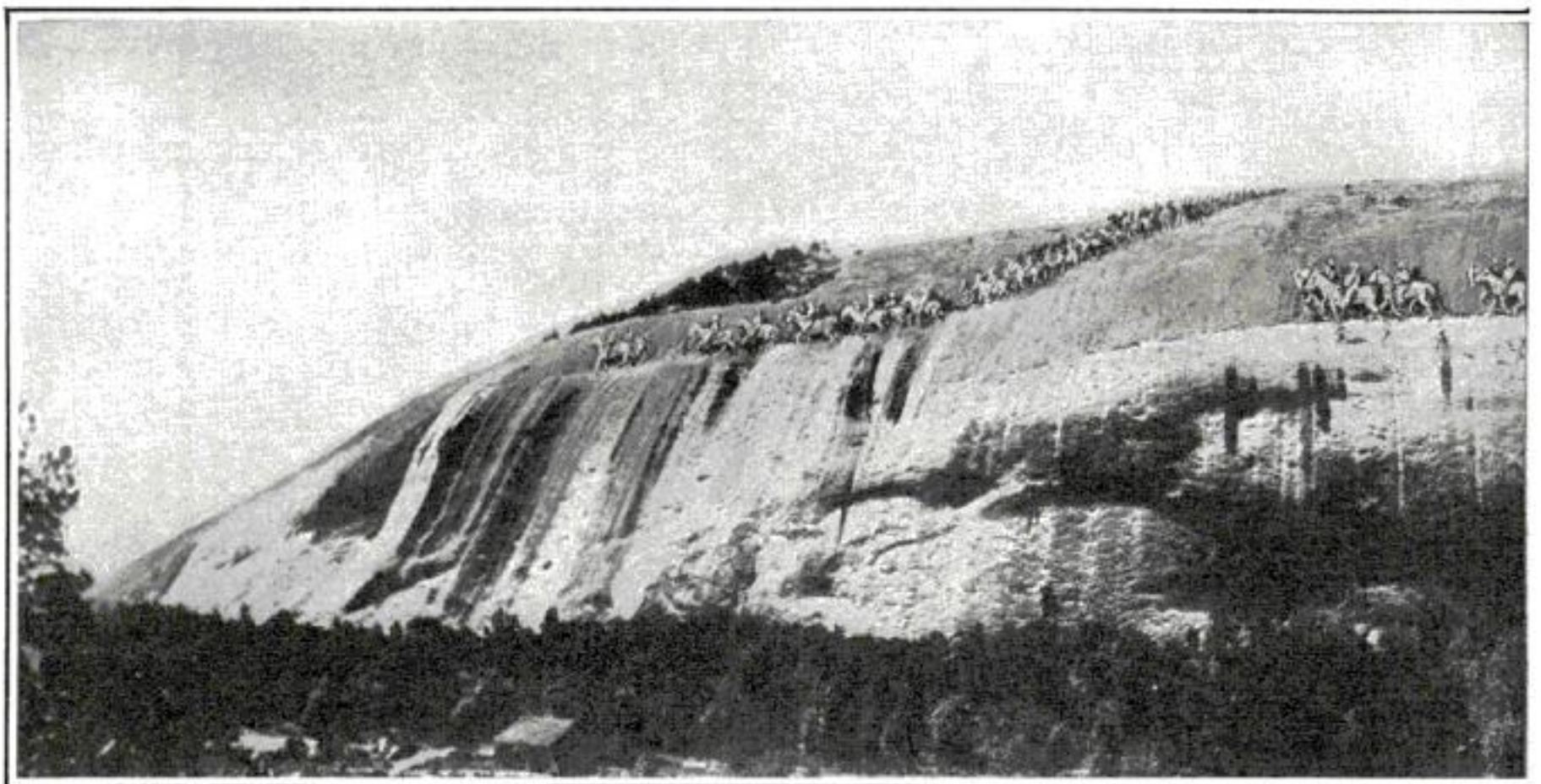
THE Department of Agriculture asserts that on the average farm a flock of one hundred to one hundred and fifty hens is more easily made profitable than a flock of one thousand.

A Top That Never Stops Spinning

ELECTRICITY has invaded the young boy's field of sportsmanship. The record spin in the game of whose-top-can-stay-up-longest has been shattered so badly that the cord-spun top, in comparison, really does not spin at all.

A top which will keep on spinning forever —or until its battery wears out. It affords indeed "endless" amusement

Like most other things that electricity takes a hand in, the electrical top does not topple after a mere spin; it whirls on for hours, according to the desire of its youthful operator. The top, in reality, is a miniature electric motor turned on end. In place of the steel peg and the sidewalk, there is a steel shaft which revolves in a bearing, and instead of the wooden pear-shaped body, there is an iron armature wound with wire. At the top of the shaft varied colored disks are placed. When the current from a dry battery is turned on, the shaft revolves and the disks spin, giving a pleasing effect in rainbow colors.



The march of the Confederate Army as it is to be immortalized in the living granite of Stone Mountain, near Atlanta, Georgia. On the face of this mountain hundreds of men will be

Carving the Confederate Army in a Granite Mountain

A MONUMENT to be carved out of the living granite of a mountain, a monument of flawless granite two miles long and a thousand feet high—to be built as an everlasting memorial to the people of the South and the cause of the Confederacy—such is the gigantic task allotted to Gutzon Borglum, one of America's foremost sculptors.

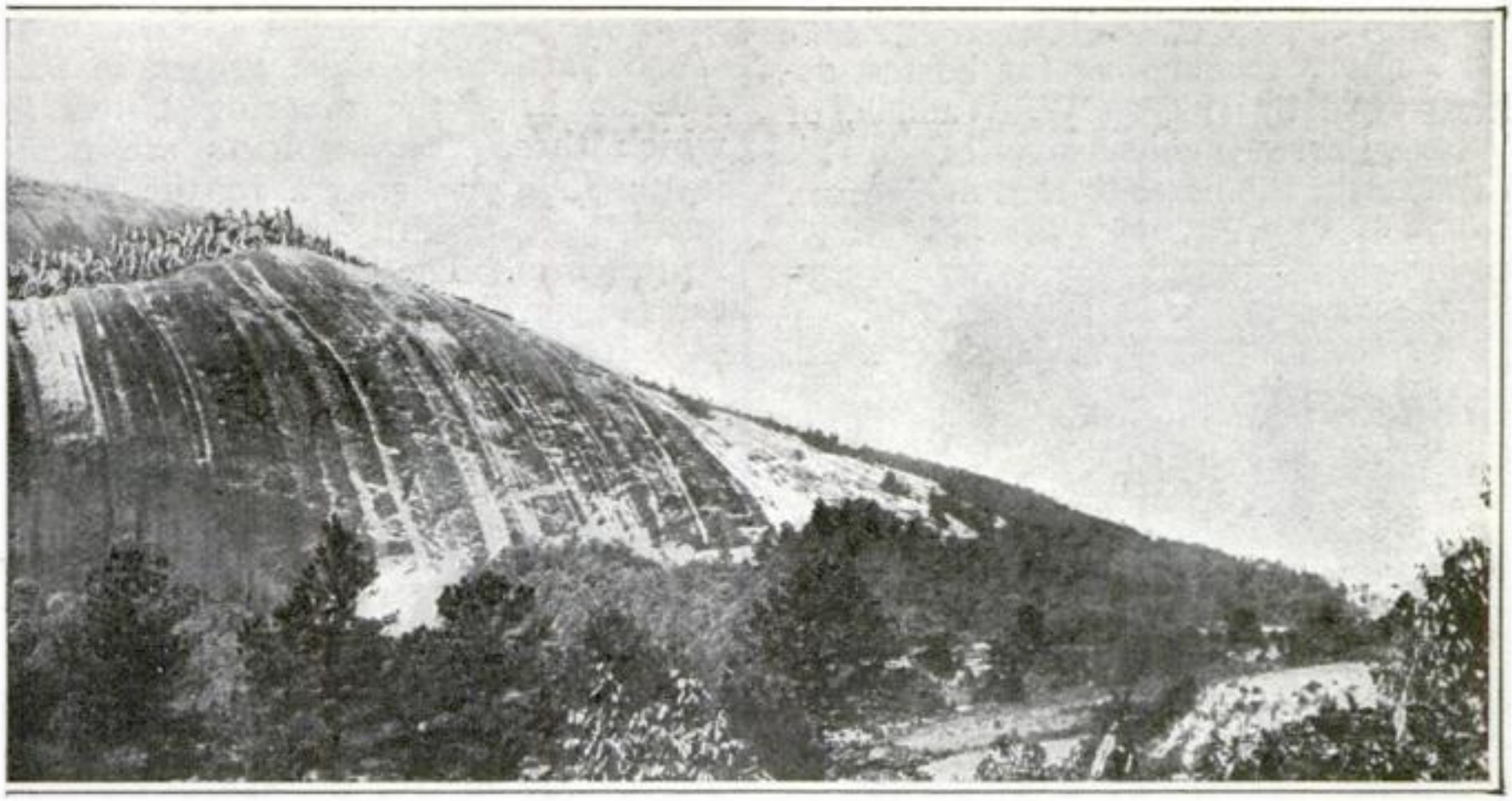
This great monument is to be carved from the solid granite composing Stone Mountain, which is located near Atlanta, Georgia, and which is called "the largest pebble in the world," since it is one solid stone, two miles long, without a flaw or a fissure in its entire surface.

Upon the face of the mountain hundreds of men will be engaged for eight years in carving companies of giant figures representing the Confederate Army and its famous generals on the march. Should Mr. Borglum wish to complete the task alone, he would have to live for centuries. The central portion of the group, bearing the likeness of the leaders of the army on horseback, will be approximately thirty-five to fifty feet high. The line of marchers will be nearly two thousand feet in length.

Each State of the Confederacy will be represented by one of the generals who led the Southern Armies, and the characters will be selected by committees from the various states. Thirteen immense columns will also be cut in the base of the mountain, to represent the thirteen Confederate States.

The difficulties of construction, Mr. Borglum asserts, will not be great. He will build a studio, about one hundred feet long, squarely upon the axis of the face of the mountain, and from three-quarters of a mile to one mile from its face. In the side of the studio he will have a window of such length as will show the full field of the mountain intended for the figures. Then he will draw the figures on the window to scale, cross-lining it, and on the mountain, as it appears on the window, he will draw in the entire work on the window itself. By a little imagination, the drawings on the glass will appear as figures on the actual stone.

By shifting his position the sculptor can shift the whole scheme of his design to any part of the mountain; and by moving towards or away from the



engaged for eight years in carving scores of colossal figures, representing the Confederate Army and its famous generals on the march. The portait studies are all to be likenesses

window he can increase or decrease the scale of the figures.

Cut into the heart of the mountain will be a memorial hall, running the entire length of the colonnade. In this imperishable hall will be kept the valuable records and relics of the Daughters of the Confederacy, as well as records of the Southern States.

A park of eighty acres will be laid out at the foot of the mountain, and from its path a suitable view may be obtained of the principal figures carved in the rock.

The cost of the work, which is now estimated at about two million dollars, will be raised by individual contributions from the entire people of the South. It is said that several wealthy people have offered to finance the entire project, but it was deemed best to make this a popular undertaking, so that it may more truly represent the spirit of the American South.

The Bridge That Telephones Built

THE building of the great railroad bridge which spans Hell Gate, was greatly expedited by the telephone. The work started last January, and in October of last year the steel arms that had been insistently creeping over the river from shore to shore were joined with the aid of a telephone system, which in itself was a fitting climax to one of the greatest construction feats the world has ever seen.

Telephones were located in the power houses, the offices, in the erector cabins, at the jacks, at the compressor house and on the structure in close proximity to the boss riveters.

The critical moment came on the day when both arms were completed and were ready to be lowered into alinement. The completed arms hung in midair exactly twenty-two and one-half inches out of alinement. The traveling erectors had been shoved out to the last eighth of an inch, another shove and they would have tipped everything over, and ruined a year's work, to say nothing of some twelve million dollars in steel.

Gages were affixed to the sides of the final beams marked off to the thirty-second of an inch, and at the exact spot the foreman stood with the telephone attached to a girder directly in front of him and with every station cut in and open. Every man knew his job and every man repeated back his telephonic order. It was a gigantic and responsible task to put up to the telephone, but the 'phone faultlessly carried the orders of the foreman over steel girders and under the East River to the men who stood at the pumps, the erectors and the riveting machines.

A Sensible Feeding Bag for Horses

A NEW feeding-bag for horses, devised by George W. Waddell, of Wilkes-Barre, Pennsylvania, makes it possible for the horse to feed in comfort.

The old and the new way of feeding a horse

This feeding-bag is bowl-shaped and not of cylindrical form. As it has hooks at its four corners from which straps and buckles extend to the horse's collar, it is much more readily fastened to the harness than the old-style bag. It is readily cleaned and emptied, which cannot be said of the old feeding-bag. Besides, it can also be used for watering the horse. Unlike the old-style feeding-bag, it can be folded perfectly flat when not in use and placed under the wagon-seat.

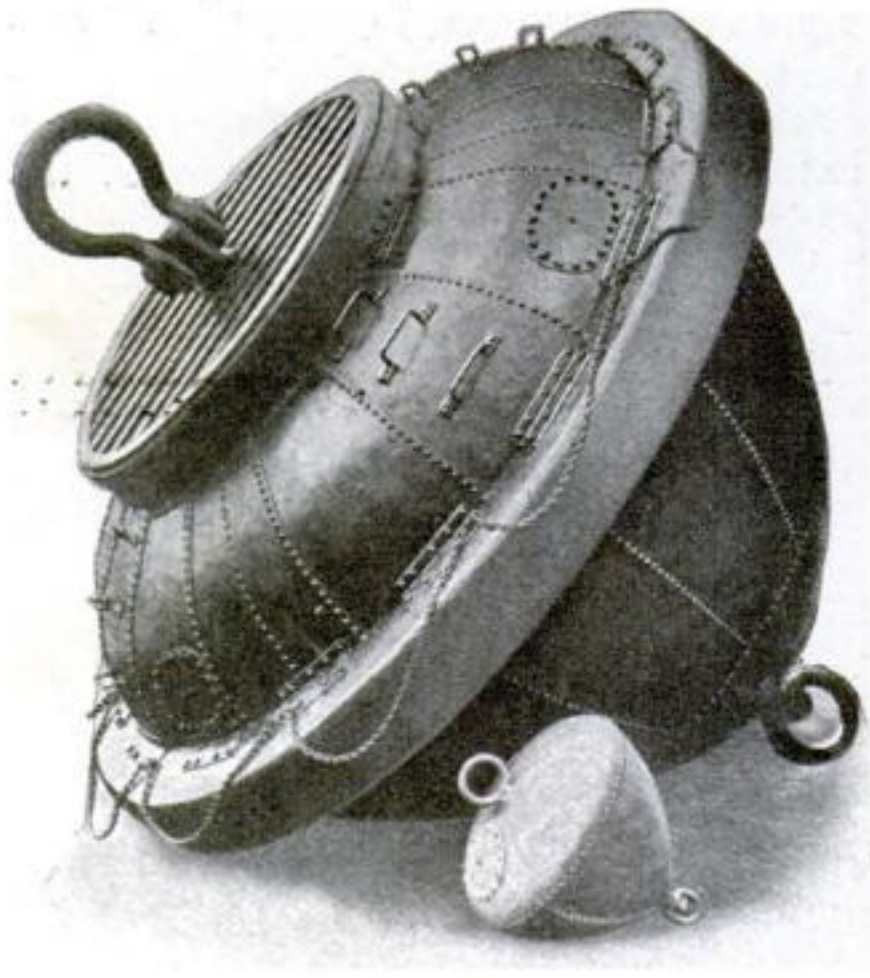
The accompanying illustration contrasts this modern, sanitary feeding equipment with the poorly-ventilated bag, that has to be tossed about by the horse if he wants to reach the last mouthful of oats at the bottom.

A Dreadnought's Buoy.

AS battleships have grown in size so have the mooring buoys to which these floating forts are made fast. The one shown in the photograph was recently turned out by a British firm. The buoy measures eighteen feet in diameter, and has a depth of thirteen feet. It is made of steel plates three-eighths of an inch thick, and has four water-tight compartments. A forged iron mooring bar passes through its center. It will withstand a breaking strain of 185 tons.

A wooden fender on the outside of the buoy protects it from collisions. This is made of elm and is one and one-half feet wide and about the same dimensions in depth. With mooring bar the buoy weighs fifteen tons. It carries a load of seven tons when one of the bulkheads is filled with water.

The smaller buoy seen in the photograph has a diameter of three feet and weighs two hundred pounds.



The buoy of a dreadnought has a platform all around on which the sailors can walk to attach the cables. The small buoy is of ordinary size—three feet in diameter

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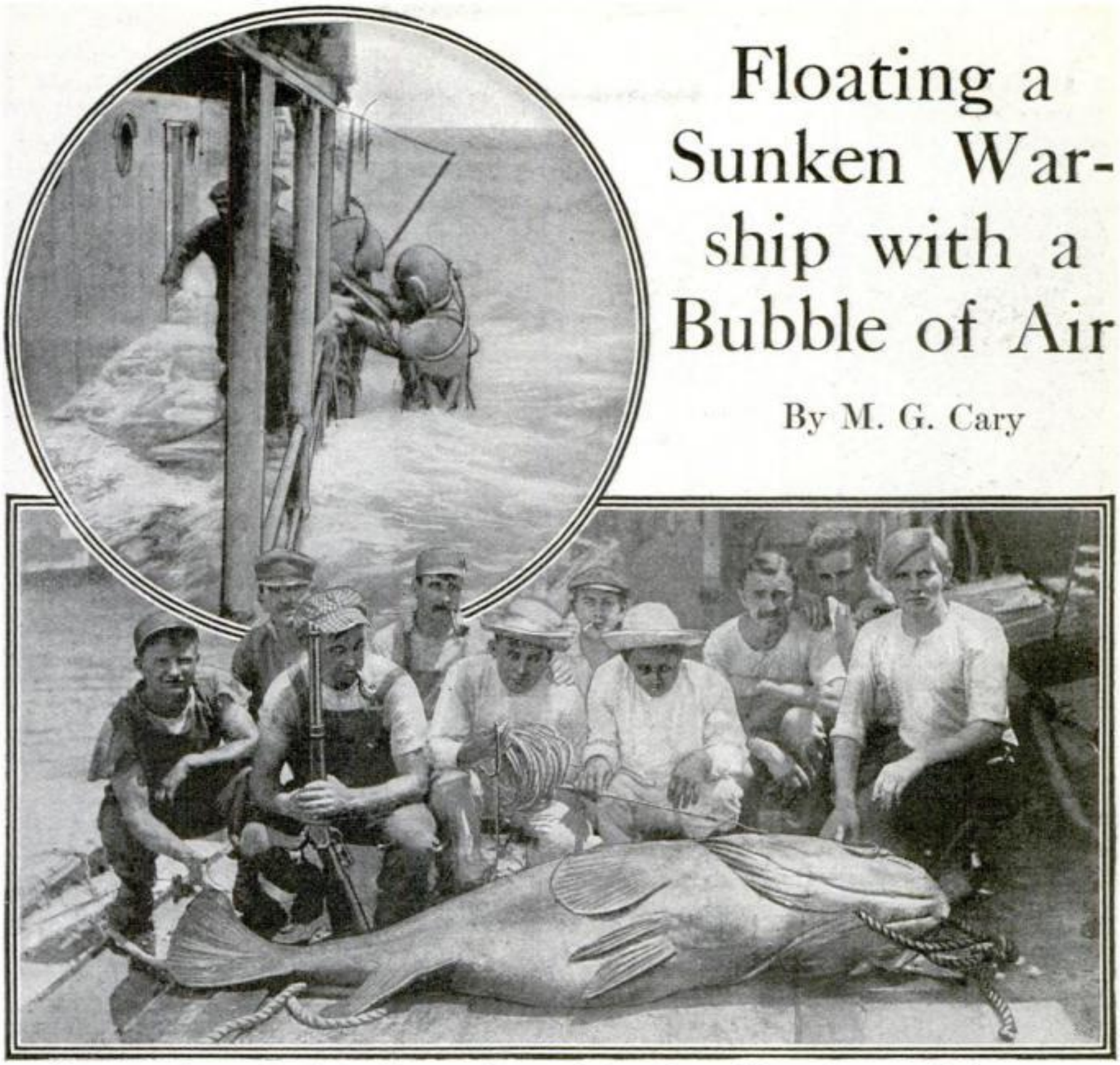
If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish, free of charge, names of manufacturers of devices described and illustrated.

Floating a Sunken War-ship with a Bubble of Air

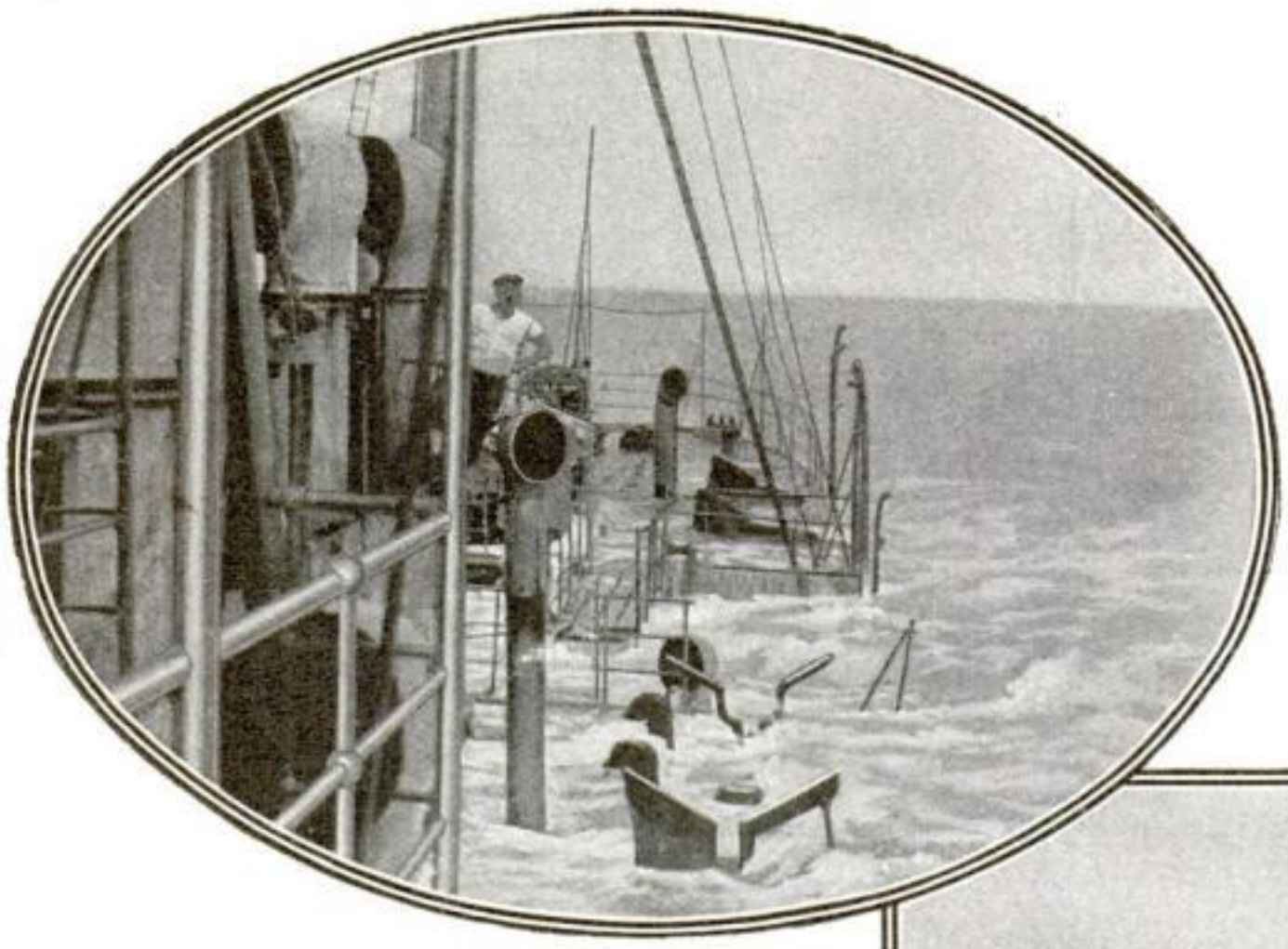
By M. G. Cary



Two great dangers faced the divers on the wrecked gunboat. The surf constantly beat over the ship and made it almost impossible for the divers to work, and numberless man-eating fish were attracted to the scene. The men had to work in large cages for protection

SALVING the Mexican gunboat *Progreso,* sunk by one of the factions opposed to Carranza at Progreso, Yucatan, was interesting because the vessel suffered an injury identical with that which would have been caused had she been torpedoed. What is more, she was converted by compressed air into a huge bubble, so that she was able to make a long voyage under her own steam. The repair, while provisional, was almost permanent. It was a steel patch applied while the ship was still submerged. The plates were of course bolted and not riveted, but the finished job compared favorably with one done in dry dock.

The story of how the gunboat was sunk has some of the amusing elements associated with Latin-American revolutions. When the *Progreso* was sent to Progreso by General Carranza to blockade that port, the wily Yucatecans hatched a plot. For several days the *Progreso* rolled about in big swells. Word was sent out to her captain that the Carranza sympathizers were going to communicate with him and try to send him fresh provisions. In the jail, a real Carranza sympathizer languished. He was made the unwilling tool of the plotters. Deceived into believing that he would be aided to escape, he was taken from jail, put in a boat with provisions, and sent out to the *Progreso.* As he



The ship had been sunk on a bar in the open roadstead, so that the upper works were awash. The surging of the rollers and the undertow made it difficult for the divers to work or to move about

came alongside he was closely questioned. Some of the provisions were taken aboard, among them were a number of bottles of brandy. Perhaps the brandy allayed all suspicions. At all events it was decided to hoist on board a hogshead of lard. This was found to be already slung. Half way on its upward journey it exploded, killing about thirty men, wounding nearly the same number, and incidentally sinking the *Progreso*. The poor fool in the boat (if he really had known what he was doing, his courage would rank with that of Hobson), was taken on the deck of the sinking ship and shot with characteristic Mexican promptness. The *Auxiliar,* an ocean-going tug, happened to be near, and saved the crew from the sinking vessel.

Five months later a New York salvage company was commissioned by the Mexican government to raise the ship. Ask the head of the wrecking expedition how the *Progreso* was salved, and he will answer: "By a board fence, a few lengths of barnyard netting, and a moving-picture screen." In spite of this airy description, the undertaking was fraught with many difficulties and real danger.

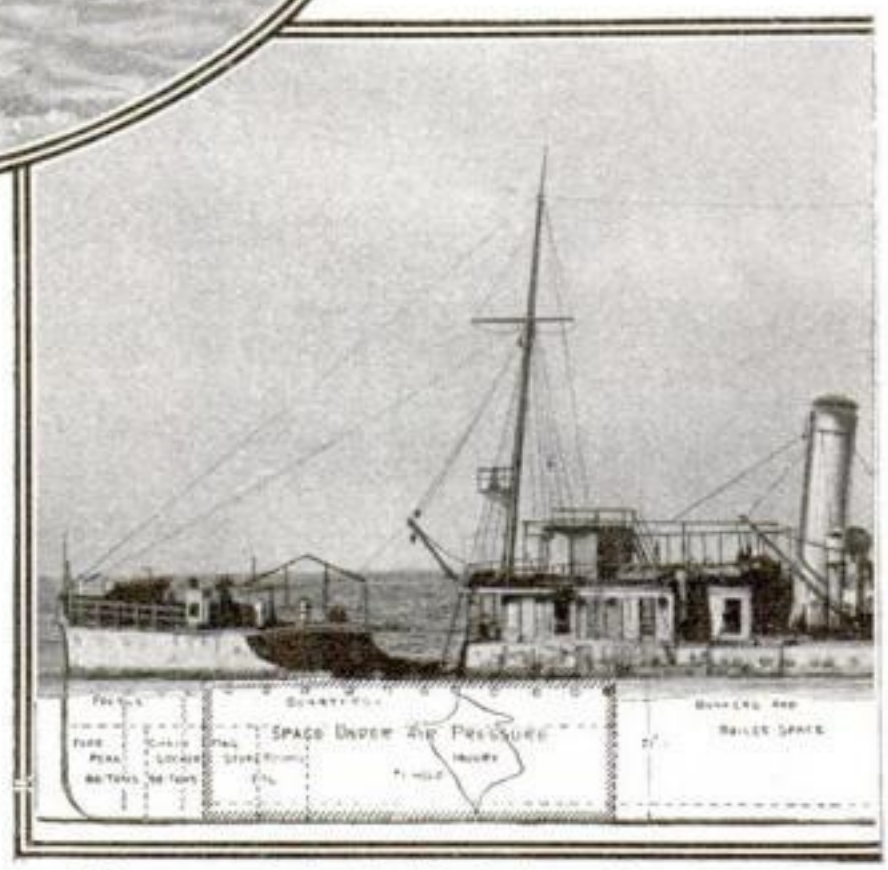


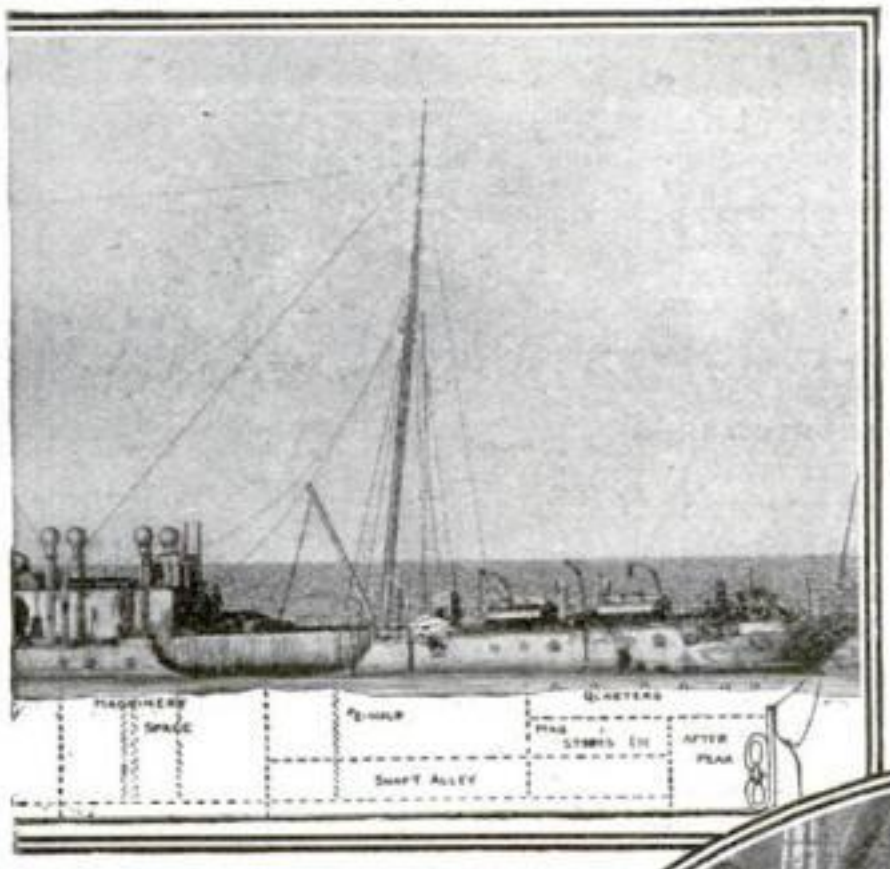
Diagram of the hold of the ship, showing the compartment which was filled with compressed air to make the steamer rise on what was practically a bubble

In the first place the surf was heavy. The steamer sent down by the salvage company wallowed about seventeen days before it was possible to start work. The ship had been sunk in the open roadstead, but upon a bar so that the upper works were awash. Before the wreckers could start to raise her it was necessary to seal every opening; glass deadlights, hatches and bulkhead doors had been blown away. The surging of the rollers and the undertow made it hard for the divers to work or to maintain their footing. Even at low tide the obstacles were formidable, for the surf broke about their heads, and the heavy diving suits hampered them because they were not completely submerged.

Cages Saved the Divers from Sharks

Man-eating sharks added to the hazards of the work; for they were attracted by the noise of hammering, and had to be fought off many times. Even more savage than the man-eating sharks was a

peculiar fish with a cod-like head, called *tinteraro* by the natives. Finally the engineer hit upon the plan of caging his men. Uprights were placed on the four corners of the weighted scaffolds upon which the divers stood, and wire netting was run around the three sides. The *tinteraros* would make a rush for the men, but stubbed their noses against the netting. Men were always on duty with pikes to assist if the cage should give way. After nightfall the fish were attracted by hundreds, and it was feared that the combined weight of many of them would break the netting. Fortunately, it held until the operations were completed.

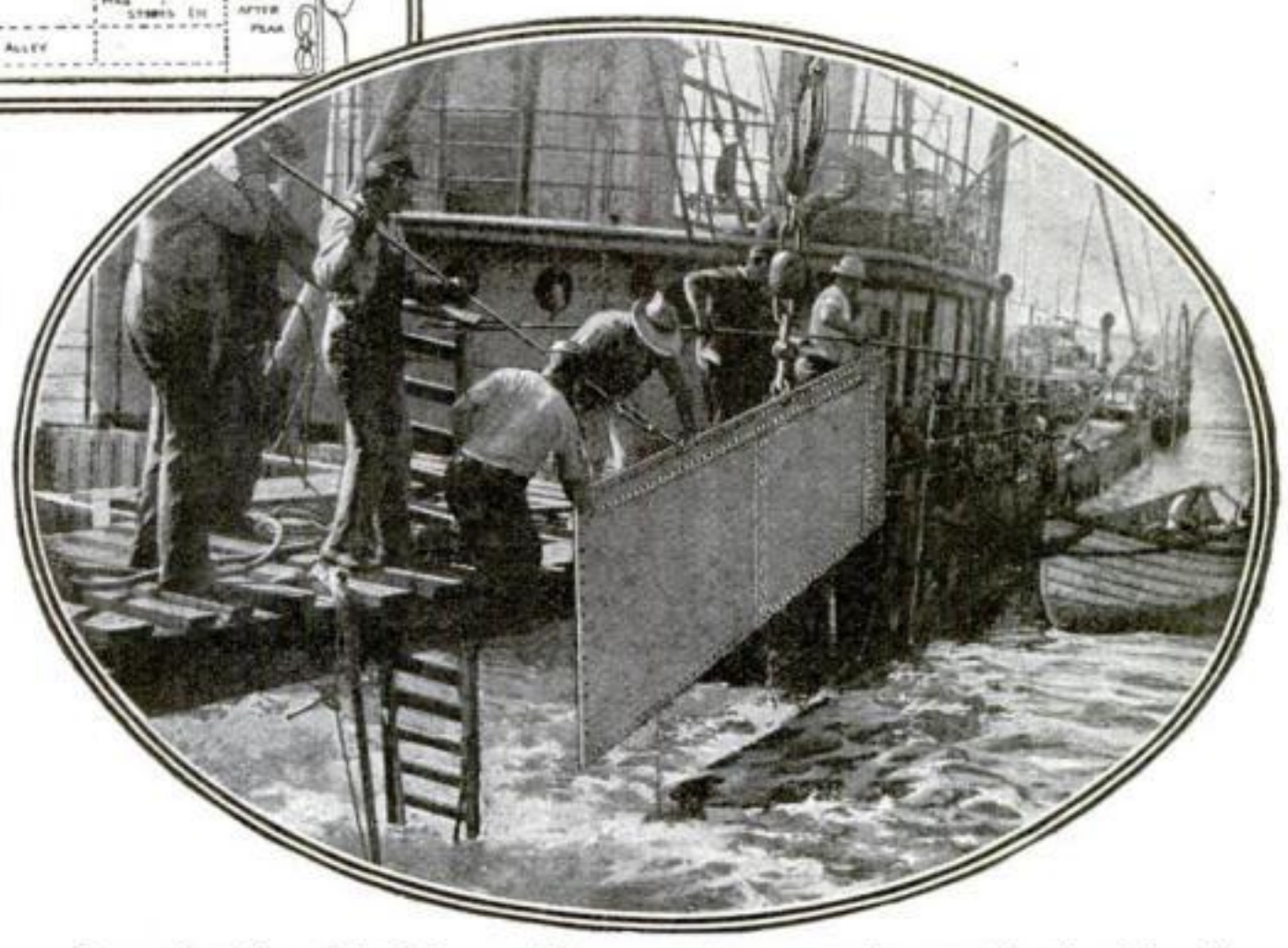


Before the wreckers could start to raise the sunken steamer it was necessary to seal every opening

cofferdam was erected on deck to bring the space to the same height and to facilitate draining the sunken body of the ship. The cofferdam is the above-mentioned "board fence," and the motion-picture screen was an eighteen by eighteen-foot canvas used inside the hull to close the wound. When all the hatches and deck were thoroughly sealed compressed air was turned into the hold, and the water receded as the canvas was put in place. After only four days of work the craft was towed toward the shore and beached. There the job was completed.

The steel patches were put on when the rent was still below the surface of the water, but where the surf could not harm her. A template was made to lay out the plating, i. e., a full-size pattern to show the exact size and shape of the hole and the location of any existing rivet-holes in the plating which might still serve to attach the new plates. The plating required was then laid out and drilled on deck.

Meanwhile the sand hogs, working in the compressed air, had driven out the rivets in the plating of the ship, where the holes would serve for the new plates. At certain points they drilled new holes, putting a wooden plug in each. The steel patch was then lowered section by section, by a derrick. Starting at the top, these sections were bolted in place over the rent. One by one the bolts were



Lowering the plate into position so as to cover the vent in the side of the ship, made by the explosion. This was done under the direction of the divers by the derrick on the ship's deck. The divers placed it in position and set the bolts, which were fastened on the inside with nuts

put in from the outside by the divers. As the sand-hogs on the inside removed the wooden plugs from the rivet holes, they also put in the nuts and bolts. In the vicinity of the injury, the frames of the ship were entirely destroyed, and they were supplanted by a new structure of heavy timbers. To make all this bolting tight, gaskets of red lead and lamp wick were used. Also, due to irregular contour of the hull plating, in many places it was necessary to fill in with concrete. Once before this method had been utilized, and by the same man, Mr. W. W. Wotherspoon, and that was when the *Royal George* went down in the St. Lawrence River.

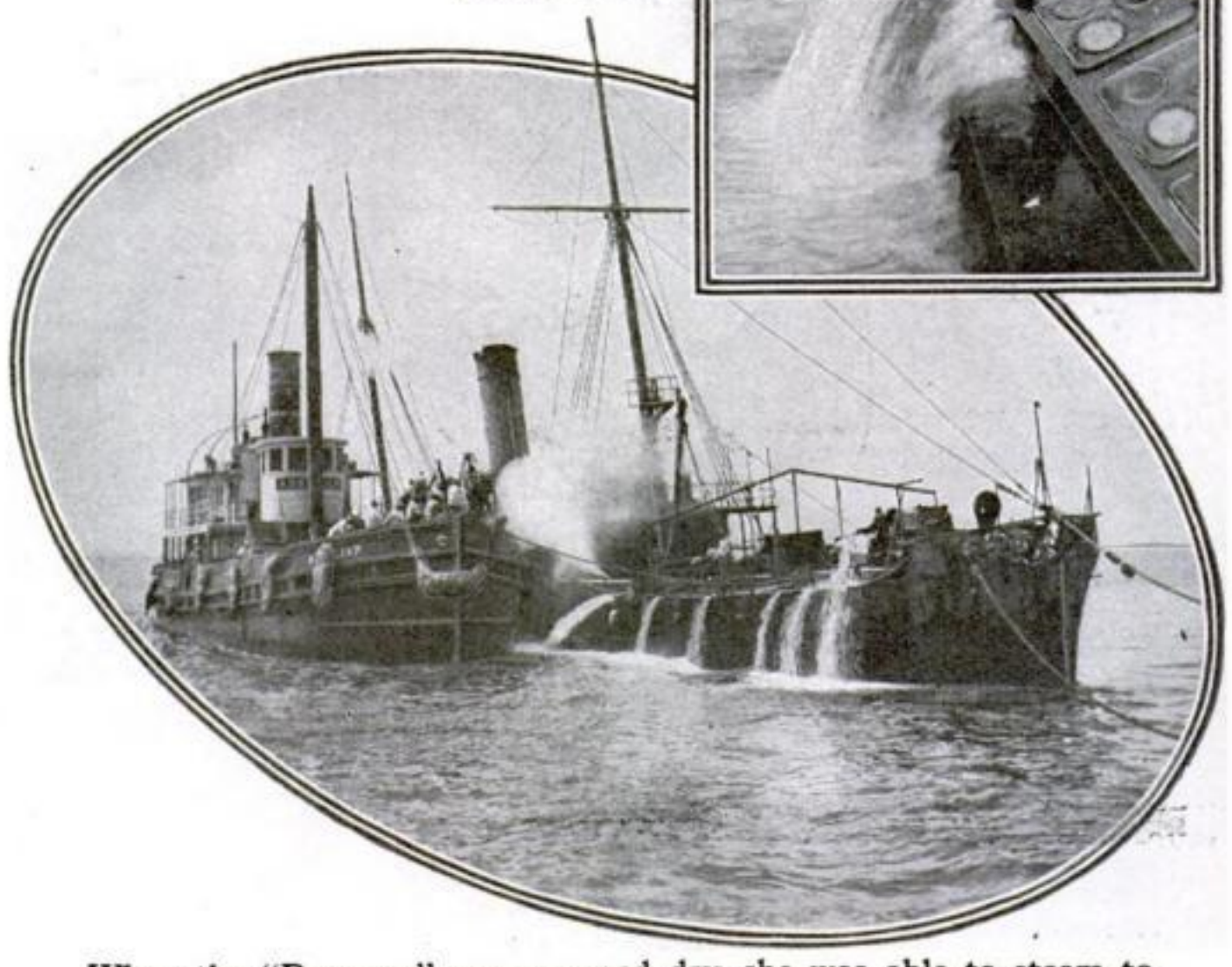
Thus patched and plugged, the *Progreso* was finally pumped dry. She was then able to make a sea voyage to Vera Cruz under her own steam. After an examination it was decided that the patches would be allowed to remain as they had been placed, until a slight amount of work could be done to put her into excellent condition while in a New York drydock.

The *Progreso* is a vessel of fifteen hundred and sixty-five tons displacement, measures two hundred and thirty feet in length by thirty-four foot beam, has engines of 1,380 horsepower, and mounts four-inch guns.

The method by which the *Progreso* was raised is substantially the same in principle as that used in driving tunnels under the bed of a river. When the tunnels under the Hudson River were constructed, a "shield" was driven forward by hydraulic jacks. The men who dug and blasted the earth and rock encountered by the shield passed through air-locks; in other words, chambers in which air was forced at such high pressure that the river water was held back and prevented from inundating the workmen. Some conception of this air pressure may be obtained when it is considered that during the construction of the Pennsylvania railway tunnel under the East River a man was actually blown up through the mud of the river, arriving at the surface none the worse for his experience.

It is evident that a kind of air-lock was created in the forward hold of the *Progreso* and air at such high pressure was forced in that the sea water could not push its way in.

After the holes in the hull of the steamer had been patched with sheets of steel, and the forward compartments filled with compressed air, the powerful salvage pumps were started, and the vessel was quickly pumped dry



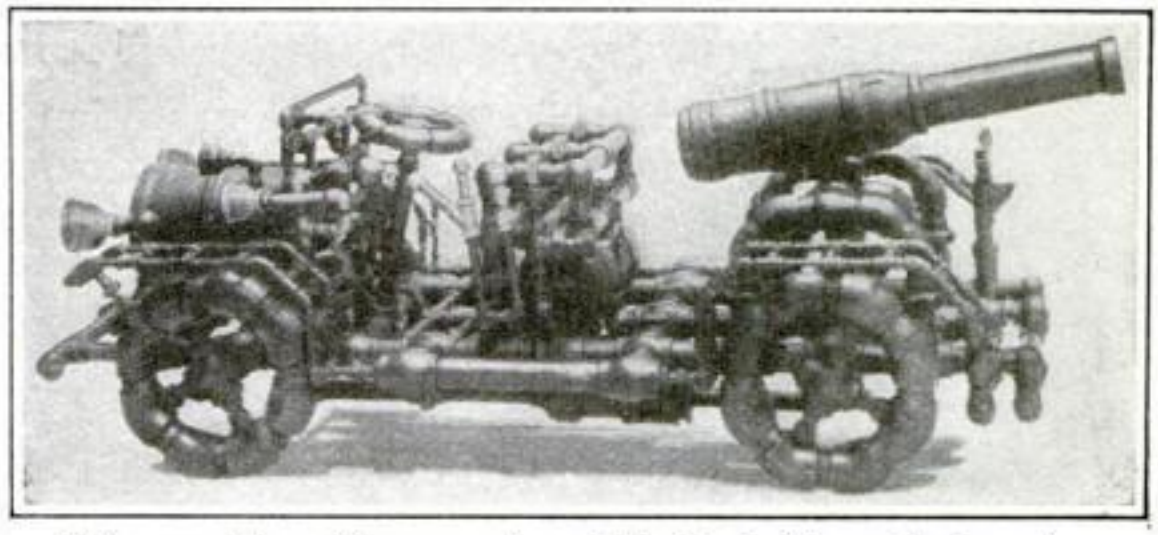
When the "Progreso" was pumped dry, she was able to steam to Vera Cruz, where she was dry-docked and thoroughly examined

A Military Automobile From Fittings

ONE of the most painstaking pieces of pipe-fitting work ever exhibited in this country is a model military automobile built entirely from malleable and cast iron fittings and so admirably put together that the wheels are almost perfectly round. The detail, even to the smallest parts, is very perfect and well proportioned.

The model contains one thousand one hundred and twenty-nine separate pieces and weighs seven hundred pounds. It is six feet long and two feet and four inches wide. It was built by Julius Genor of Bridgeport, Conn.

Although the material of which it is composed was cheap and easily obtainable, the model represents an immense amount of fine machine work.

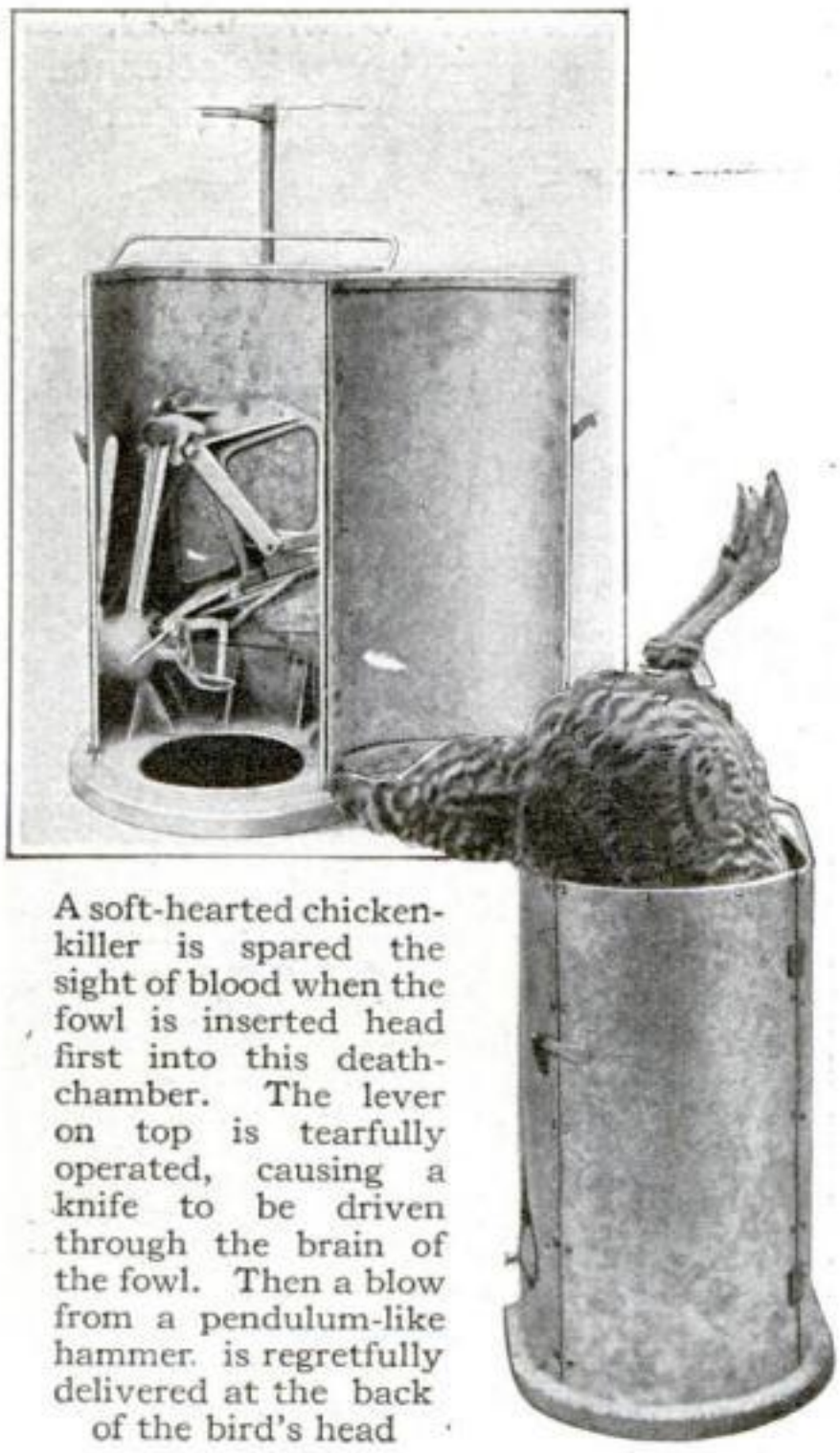


This model military automobile is built entirely of malleable and cast iron fittings

For Squeamish Fowl-Killers

A NEW and ladylike way to kill fowls has been devised by which the free flowing and spattering of a chicken's blood after lancing is prevented and the unpleasantness of viewing the whole sanguinary affair is removed.

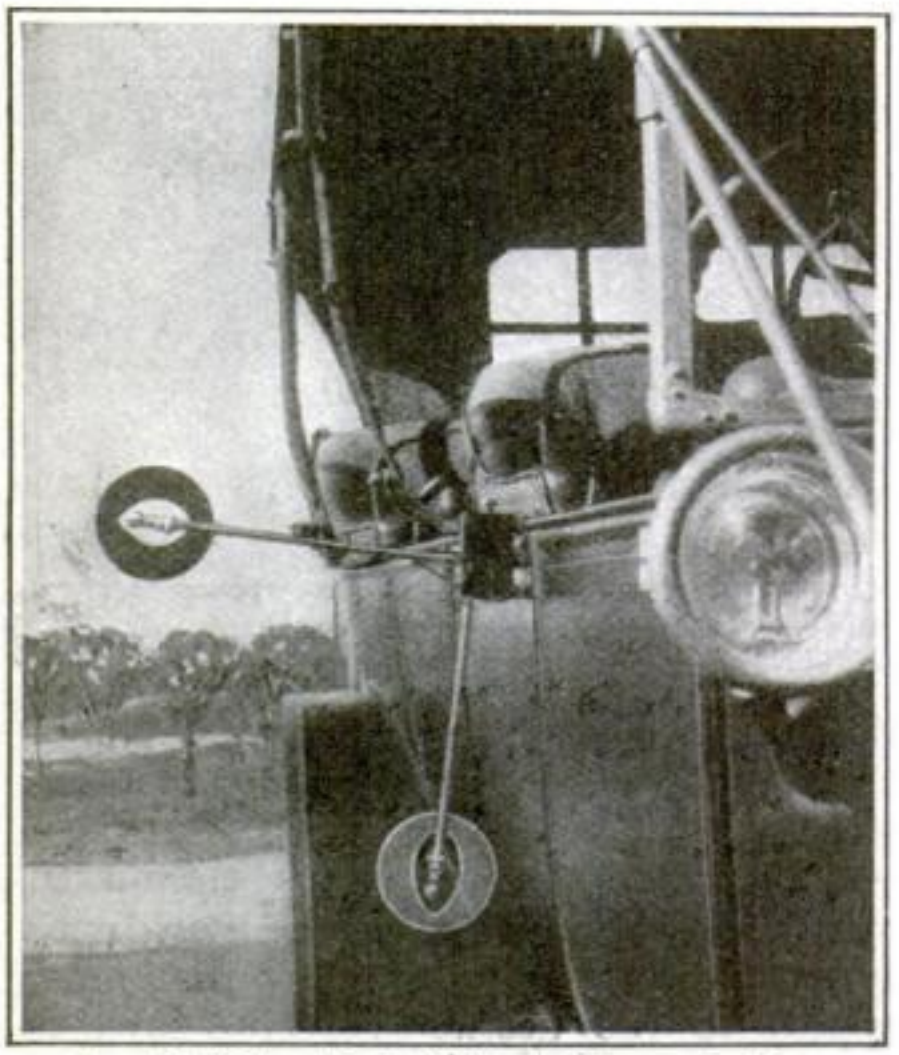
What to the squeamish is the most distressing feature of the poultry business —killing fowls by hand—is eliminated by a machine, which does the work with accuracy and with a delicacy that must appeal to the aesthetic. The fowl is considerately suspended by the legs from yoke-like leg clamps, with its body and head within a tubular casing. In the lower portion of this casing is a dainty head-holder with a ring, in which the bill is inserted. A V-shaped collar is pushed into position and tenderly locked in place over the front portion of the neck of the fowl. The door to the casing is then decently closed, shutting the fowl from the horrified view. Next a lever extending out from the casing is boldly operated, causing a knife or lance to be driven through the brain of the fowl. To relieve any doubts that still linger a blow from the pendulum-like hammer is immediately thereafter delivered at the back of the head of the fowl. To relieve any doubts that still blood, which is caught in a small pan below the head, so that not even the machine is soiled. Could respect for one's feelings be carried farther? No undertaker can be more considerate. But, somehow, the old axe and the chopping block seem simpler and just as effective to our brutal mind. The fowl is certainly rather more tortured before the last quick death-blow is delivered.



A soft-hearted chicken-killer is spared the sight of blood when the fowl is inserted head first into this death-chamber. The lever on top is tearfully operated, causing a knife to be driven through the brain of the fowl. Then a blow from a pendulum-like hammer is regretfully delivered at the back of the bird's head

This Automobile Signal Takes the Place of Your Hand When Rounding a Corner

THROUGHOUT the country it is the practice of motorists, when they are about to turn a corner, to extend the arm out of the car at the side toward which they intend turning. Drivers have learned to look ahead for this notice. The unusual signal here shown comes nearer to the extended arm than anything that has thus far made its appearance.



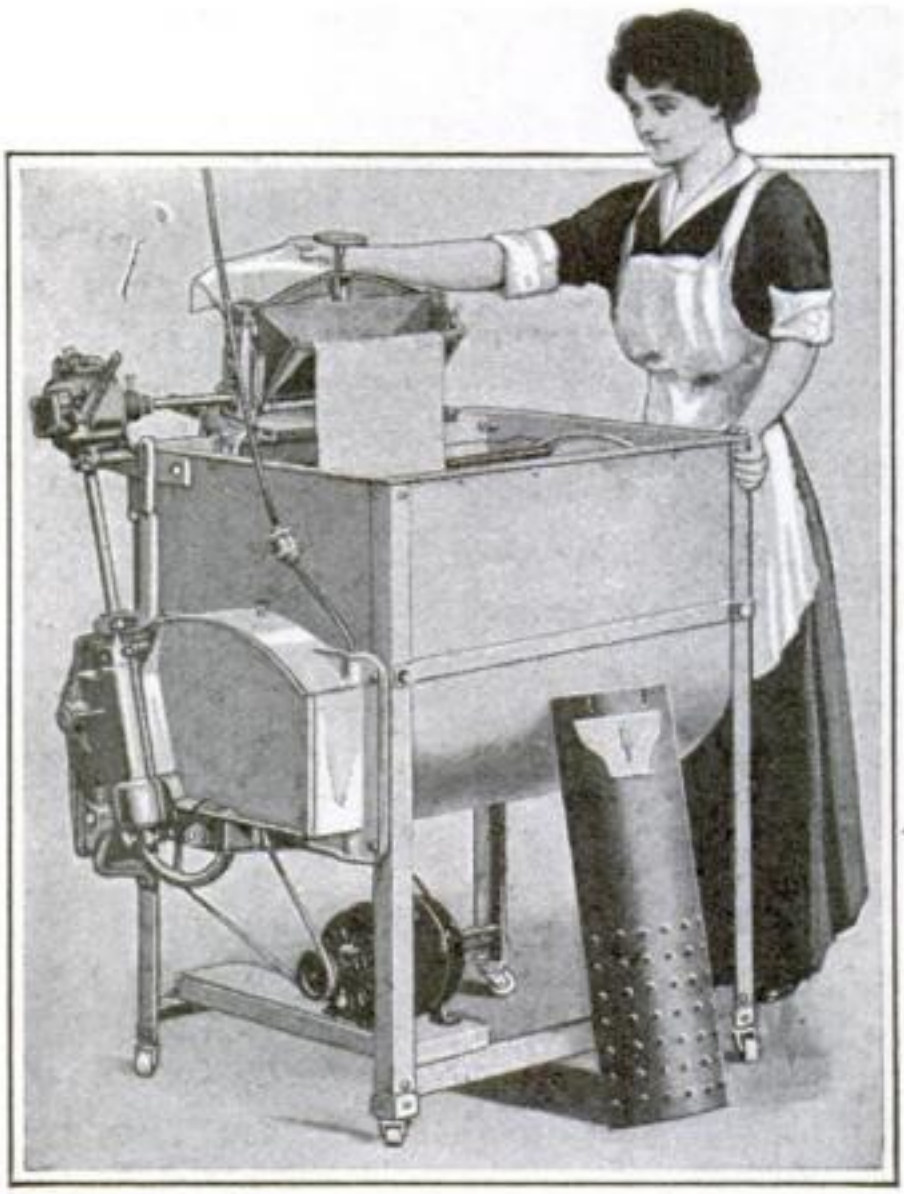
A red disk, raised by pressing a button, takes the place of the motorist's extended hand in making a turn

Upon approaching the corner the driver of the car, which is equipped with a pair of these signals, simply presses a button which is located at the top of the body near the side of the seat. As this button is pressed it operates a mechanism, which in turn swings this arm-signal outward from the side of the car so that it may be plainly seen by the driver of the machine that is following. When the corner has been turned, the button is again pressed, this action permitting the signal to drop down against the side of the car. This signal is equipped with a red disk for use during the hours of the day and a tiny electric lamp for night driving.

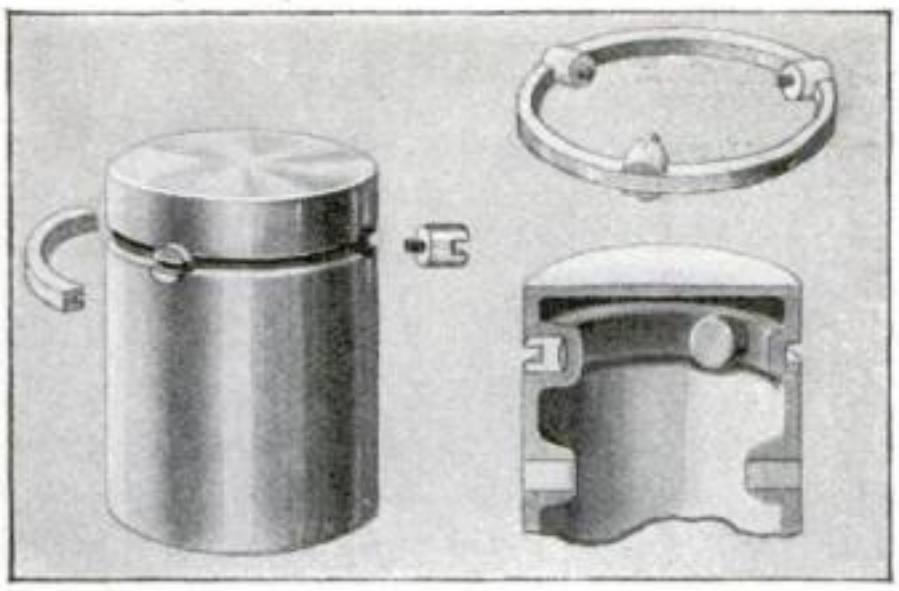
We are told by experts that seventy-five per cent of the driver's steering efficiency is lost the moment the arm is extended outward from the side of the car. By the use of this device the hands of the driver are upon the wheel when the corner is actually being rounded. The arm of this signal is about fourteen inches in length, twice the thickness of the ordinary lead pencil, and the disk is about six inches in diameter. With the exception of the disk and the globe, the contrivance is painted black, and everything except the small lamp is mechanically operated. The device is the invention of W. F. Irwin of Los Angeles, Cal.

A Safety Wringer-Guard

AS wringer rolls revolve very rapidly when operated by an electric motor the element of safety to the hands of the laundress is important. A new wringer-guard has appeared, the inventor of which has kept this in mind. In feeding the clothes into the wringer the hands are kept at a safe distance by this guard, the opening of which is large enough for bulky pieces, like blankets. The guard may be attached to either side of a reversible wringer.



The need of a guard to prevent injury to the fingers in an electric wringer has been met by this device



A new British piston ring, built on a new principle, for use on motorcycles and light automobiles

A Novel British Piston Ring

A BRITISH piston ring, especially adapted to motorcycles and light motor cars, has been constructed along entirely new lines, shown clearly in the accompanying picture. Nothing heretofore has appeared on the market, which even resembles the Gaskell ring, as it is called after its inventor.

The ring is made up from three segments, held in place by three plungers, inserted in recesses spaced equally round the circumference of the piston and slotted to receive the ring. They are held up to their work by small helical springs, which tend to press the rings against the inside of the cylinder walls. One of the plungers is fitted at the center with a small stud, which engages small recesses cut in the ends of two ring segments. This pin, shown on the left-hand side, prevents the ring from turning as a whole. The groove in the piston is deep, and only one ring is required, which is not distorted by being forced over the larger head of the cylinder piston into the slots. This is an advantage which cannot be gainsaid. Compression is good and frictional losses small in this type of ring.

ACCORDING to the report of the Police Commissioner of New York the policemen of that city are healthier than those of London and healthier than the soldiers of the United States Army. The average percentage off duty because of physical disability was 2.24 for New York policemen as against 2.43 per cent for enlisted men in our army, and 2.35 for the London police.

This Factory Burns "Sauerkraut" for Fuel

A WESTERN paper mill uses "sauerkraut" as a fuel for firing its boilers. Lovers of this Teutonic delicacy need not be alarmed, however, for the "sauerkraut" used in this reckless manner is not to be bought at the corner grocery store. This "sauerkraut" is a by-product of their pulp mill and looks so much like the vegetable that it was given that name in the mill.

The "sauerkraut" of the pulp mill is in reality the coarse material that is not completely ground up in reducing the logs to pulp. It is caught in screens, when the ground pulp is floated away from the machines, and is dried and delivered to the boiler rooms, where it is used for fuel.

A handful of "Sauerkraut," not the real thing, but the kind used for fuel. It is really wood pulp, the rejected portion of a paper mill's product

Why Cotton Is Contraband of War

By Hudson Maxim

Cotton: It will make a shirt to hide your nakedness or blast a subway to make transportation easier

COTTON happens to be the best combustible element to combine chemically with nitric acid so as to produce a high explosive, and also to serve as the principal ingredient for the manufacture of smokeless powder.

A bale of cotton may, therefore, be considered a bale of guncotton in embryo.

There are many kinds of nitrocellulose, depending upon the so-called degree or character of nitration, that is to say, upon the way in which it is treated with nitric acid and the strength of the nitric acid.

When ordinary cotton is immersed in nitric acid, the cotton absorbs oxygen from the nitric acid, but not as free oxygen, because the oxygen is taken up in combination with nitrogen. But the weight of the oxygen absorbed is much in excess of the weight of nitrogen, the nitrogen acting merely as a carrier of the oxygen. The appearance of the cotton is not changed to any appreciable

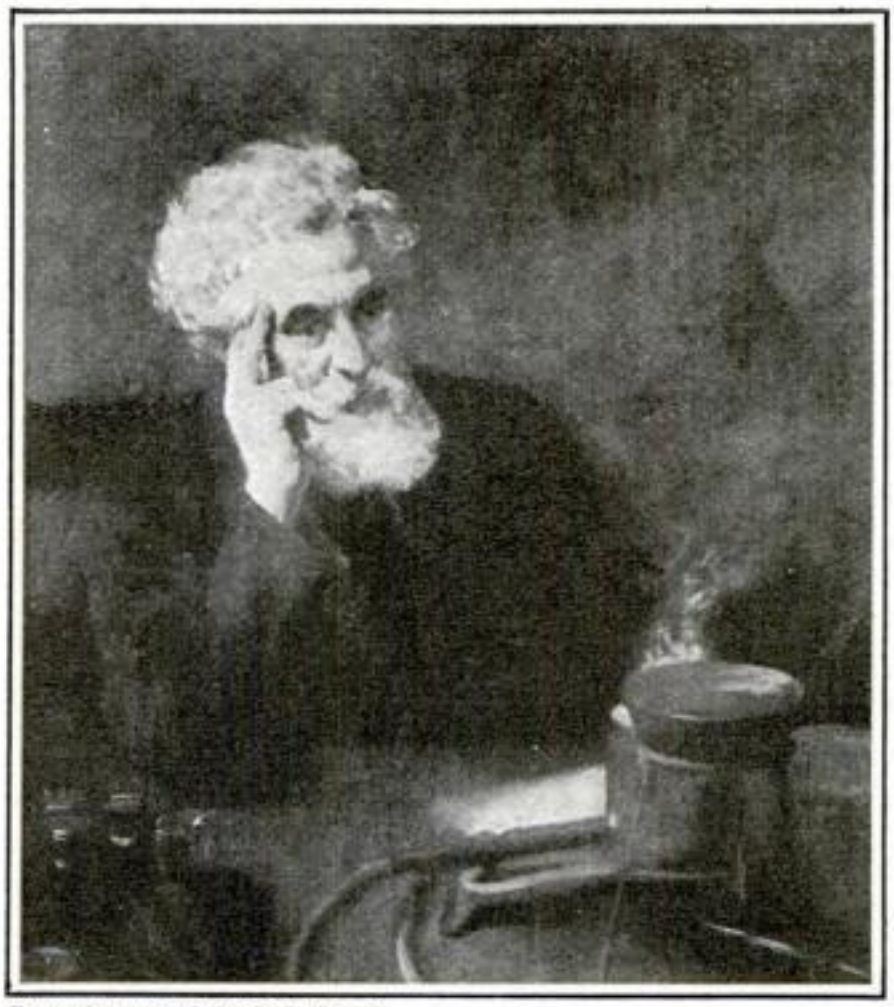
extent, but the weight of the cotton is considerably increased.

The oxygen which the cotton absorbs from the nitric acid is sufficient to consume all of the cotton without atmospheric air, so that when guncotton is put in a confined space and set on fire it explodes with great violence, producing what are called carbon dioxide and carbon monoxide, with free nitrogen and steam.

When the cotton is immersed in the nitric acid the acid takes water out of the cotton, which dilutes the acid. But the cotton gets the best of the bargain, because the weight of oxygen and nitrogen which the cotton receives is in excess of the weight given up by the cotton.

In order to keep the nitric acid bath strong enough to act on the cotton, and to minimize the acid, it is necessary to add sulphuric acid to absorb the water, and it takes about three parts sulphuric acid to one part of nitric acid to make a proper mixture for this purpose. The sulphuric acid, however, has no effect whatsoever upon the cotton. It merely acts to absorb the water liberated from the cotton.

There are several ways in which the cotton is treated with the acid mixture. The oldest and simplest was merely to immerse the cotton in the acid, and when it was thoroughly nitrated to place it in a centrifugal machine and wring out the acid and throw it into an excess of water to wash out the remainder.



From the portrait by S. J. Woolf.

If you want to know how to write poetry or blast a subway, lay out a garden or design a battleship, ask Hudson Maxim. It is no off-hand slap dash opinion that he will give, but a well reasoned statement. For Maxim believes that everything could be reduced to a science, whether it is writing sonnets to your lady's eyebrow or defending the country against foreign invasion.

But Maxim is above all an authority on explosives. That is why we asked him to write this article for the POPULAR SCIENCE MONTHLY. *He invented the process of making the multi-perforated smokeless powder used by the United States. His Maximite, adopted by the United States Government, was the first high explosive which could be sent through armor plate and burst inside of a ship. That achievement in itself was enough to make any man famous. But then he is also the inventor of Stabilite, a powder which we have every reason to regard as important because it can be made quickly in an emergency. A torpedo invention of his, intended to do away with compressed air, has also been bought by the Government. Mr. Maxim is a member of the Naval Consulting Board.*

The way that is employed principally by the United States Navy is to do the nitrating in a centrifugal machine and when the nitrating is complete to set the centrifugal machine in motion, which extracts the acid from the nitrocellulose. Thereupon the nitrocellulose is quickly and thoroughly washed.

After the washing process is completed there is a quantity of acid remaining, and also there are contained in the nitrocellulose certain unstable compounds. These are removed by thoroughly boiling the nitrocellulose in a large excess of water.

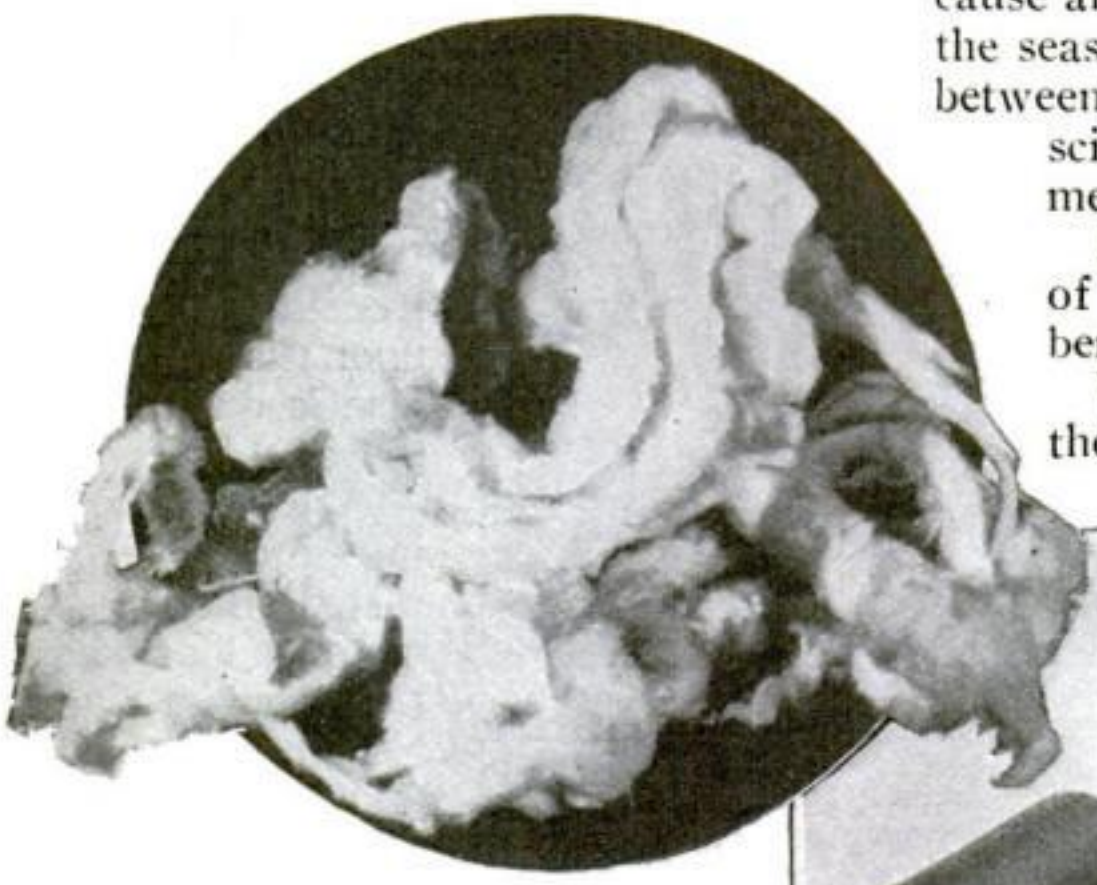
After this is done the nitrocellulose is pulped in an ordinary pulping machine, like that used in making paper pulp. When this is thoroughly done the finely pulped nitrocellulose is gathered and pressed into cylinders. It still contains a considerable percentage of water, which must be removed in order to dissolve or gelatinate it as a step in converting it into smokeless powder.

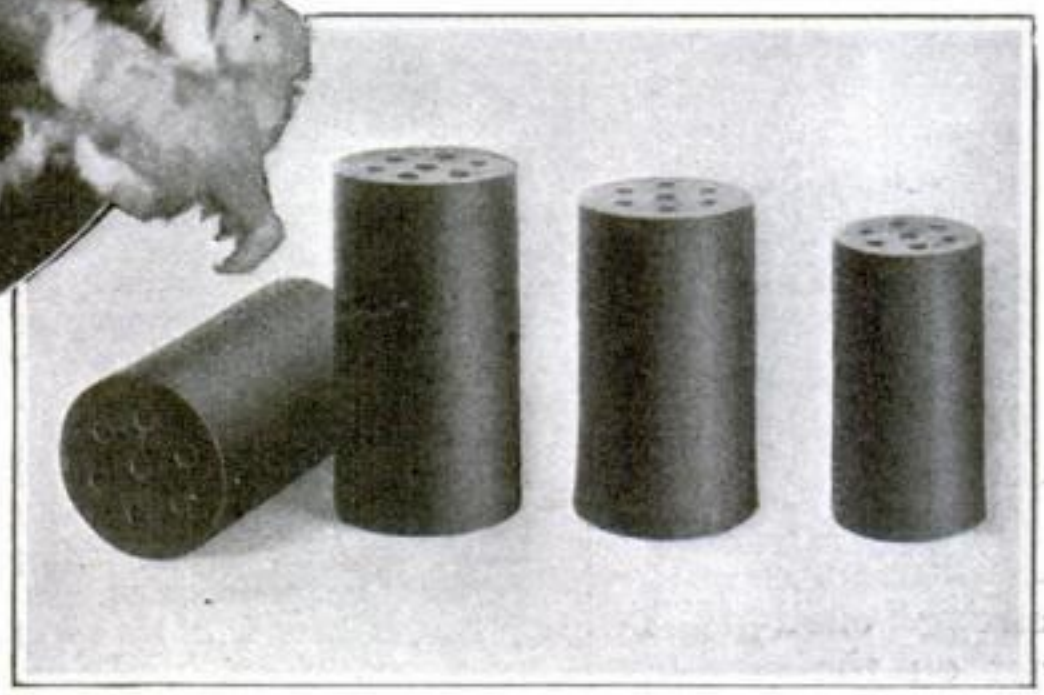
This is done by forcing alcohol under pressure through the mass of pulped

guncotton cake from the top, the water beig forced down ahead of the alcohol until it is driven entirely out at the bottom, and alcohol takes the place of the water.

This is called the replacement process, and was discovered by Francis G. du Pont. It is very important.

Making cotton contraband of war does not prevent the Germans from making guncotton from other materials. When wood fiber or fiber obtained from grass





Cotton nitrated and ready to be transformed into smokeless powder (nitrocellulose). Grains of smokeless powder (nitrocellulose) are perforated so that they can burn inside as well as outside, thus controlling the rate of gas production

is treated with nitric acid it also becomes a kind of guncotton. The German chemists are very well able to make their guncotton, and consequently their gunpowder and high explosives, from the trees of the forest.

But nitric acid also is contraband of war. How then are the Germans to get their nitric acid?

Before the outbreak of the European War the Germans had anticipated the present blockade and prepared for it. The German chemists and scientists had developed a very practical, very efficient and cheap method of producing nitro compounds from the air, nitric acid among them, by means of the electric current.

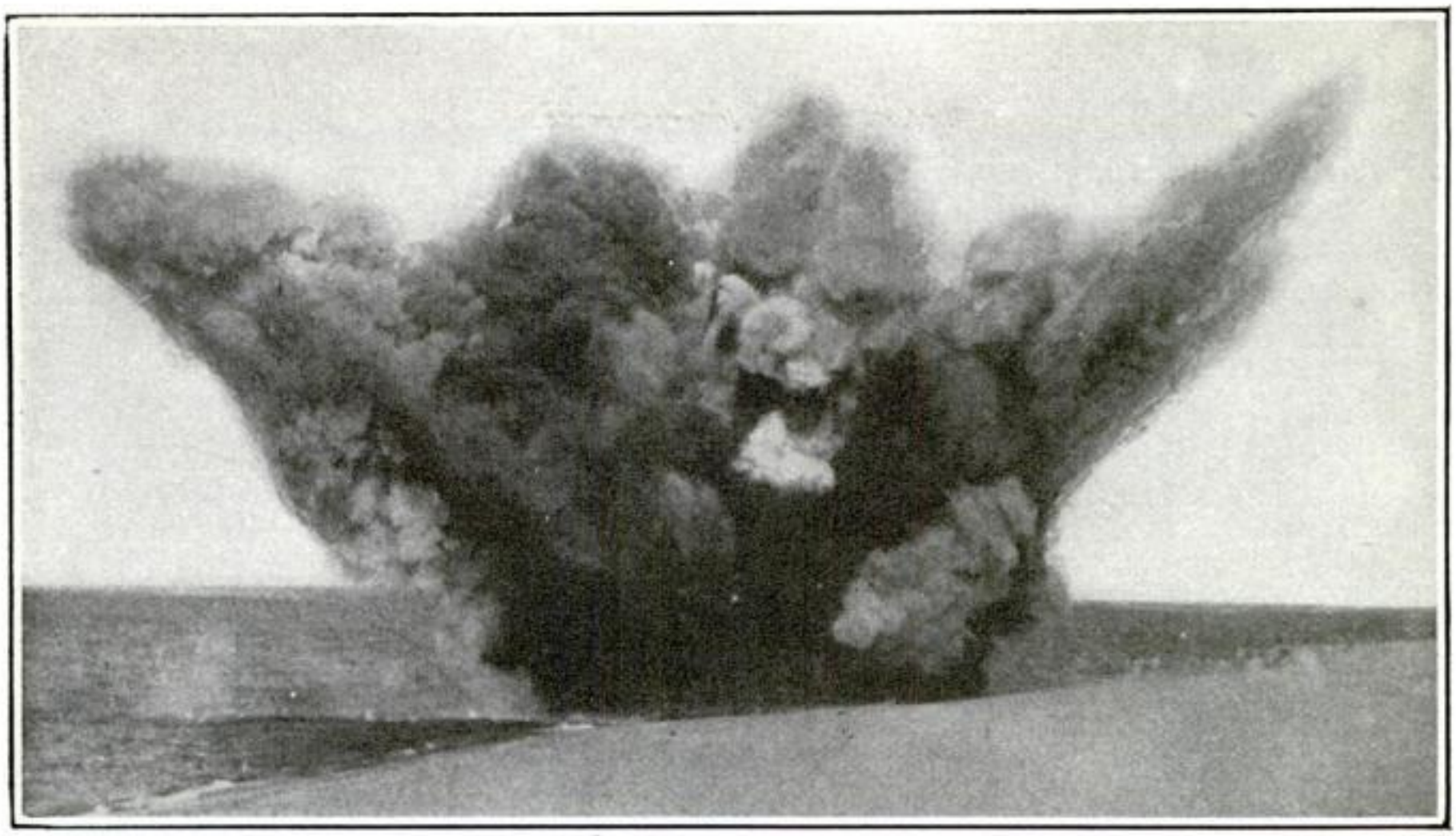
I understand that today the Germans are not only able to make all the nitro compounds they need for the purposes of explosives, both high explosives and smokeless powder, but also what they require for fertilizers for the farmers.

With a nation of scientists, chemists and inventors like the Germans, it is entirely impossible to stop them from producing explosives in any quantity they may desire, entirely independent of any class of imported materials, because although the English may blockade the seas they cannot establish a blockade between the genius of the German scientists and the German government.

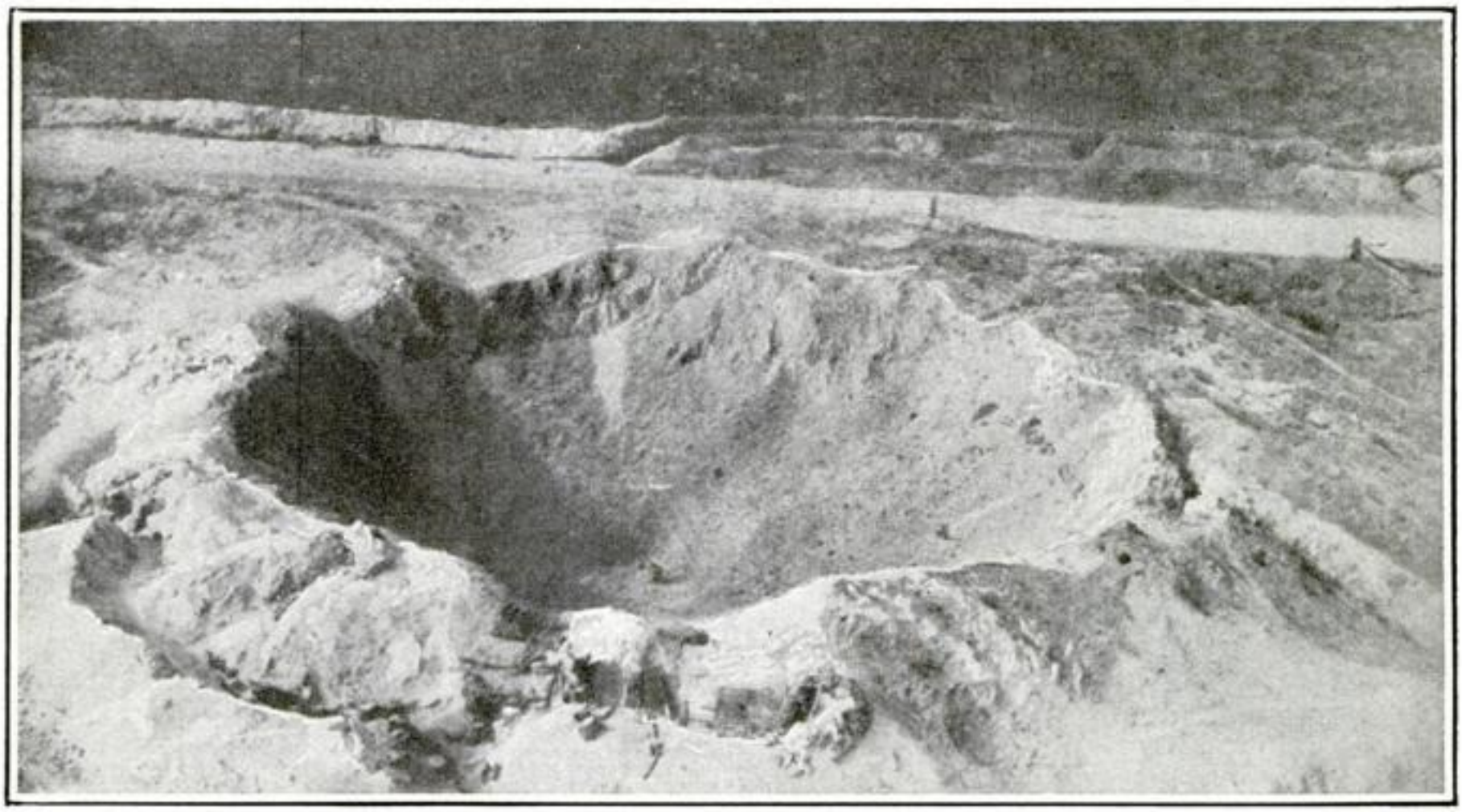
It is very curious how the trials of war often result in the most beneficial effects upon a nation.

When the English established their famous blockade under their Continental system in Napoleon's time, the French were compelled to resort to some other means than importation to get their sugar. Consequently, they developed the sugar beet, and planted it in enormous quantities, with the result that France introduced the sugar beet industry, which has been of vast importance to that nation ever since.

Likewise, the English blockade against Germany today is compelling the Germans to develop their internal industries in a most phenomenal way. They have solved the nitric acid problem, and very likely they will continue, after the war is over, to make their nitric acid and other nitro compounds from air. What is more, they will probably compete successfully with the natural nitrate of Chile.



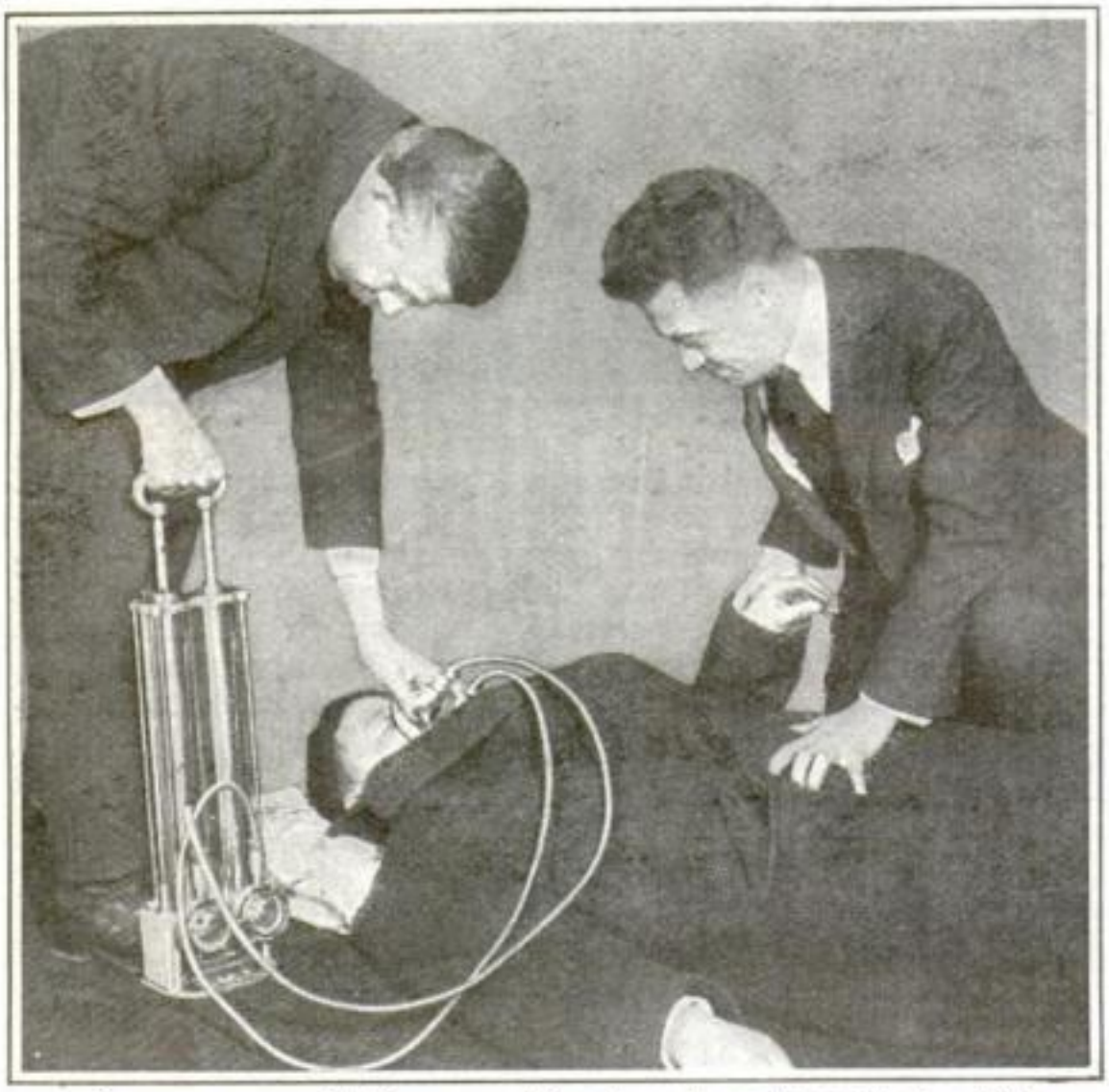
If you want to know why cotton is contraband of war this picture will tell you. It shows a Russian mine which ran ashore on the Baltic Sea and which the Germans exploded. As in all modern mines the charge was composed of a high explosive made by the proper chemical treatment of cotton. The war is actually being fought with cotton—cotton grown upon the peaceful southern plantations of the United States. So long as cotton is obtainable these high explosives can be manufactured in great quantities. Naturally, the warring countries who can secure unlimited control of the cotton supply make themselves just that much more formidable to their enemies. Great Britain watches with never-closed eyes every shipload of cotton leaving the United States



You read of "craters" in the newspapers—great holes produced either by the explosion of some huge shell or of some subterranean mine. This is a photograph of a type of crater produced by a mine. Surely the men in this war live on the crests of volcanoes—not figuratively, but literally. At any moment the soldiers in the trenches may be blown to atoms by mines charged with high explosives made from guncotton. The tremendous expansive power of guncotton when exploded, will lift many million times its own weight of matter, with a suddenness that prevents any possibility of escape for those who are within its range

Saving the Asphyxiated with a New Air-Pump

THE man pictured in the photograph is being revived by a lungmotor, which is a resuscitating machine invented by two Chicago men. It competes with the pulmotor in the life-saving work of the United States Bureau of Mines, and is being adopted by hospitals, fire companies and life-saving stations. Its usefulness extends to cases of poisoning by gases and fumes, mining accidents, electric shock, the rescue of persons apparently drowned or overcome by the smoke of fires, cases of collapse through excessive anesthesia and the rescue of infants asphyxiated at birth.



A new resuscitating machine has been invented which so nicely meets any requirements that it can be operated in a rocking boat or a swaying ambulance

The device has two independent air cylinders, the pistons of both of which are attached to and operated by one handle. Air is drawn into the inspiration cylinder on the upstroke. On the down stroke it is compressed and forced through an outlet-valve into the metal inspiration-tube and thence through the face mask into the mouth and to the lung. When the lung has been expanded until full, its natural resilience will assert itself, and expel the air into the expiration cylinder of the lungmotor. Suction action is avoided.

The lungmotor introduces a small volume of air at a time, and keeps a full volume of air in the lung. The natural resilience of the lung comes into operation as a safety-valve in forcing out excessive air and obviating the dangers that attend the introduction of too great a volume of air, which would cause obstruction to the flow of blood to the lung and prove disastrous to the patient.

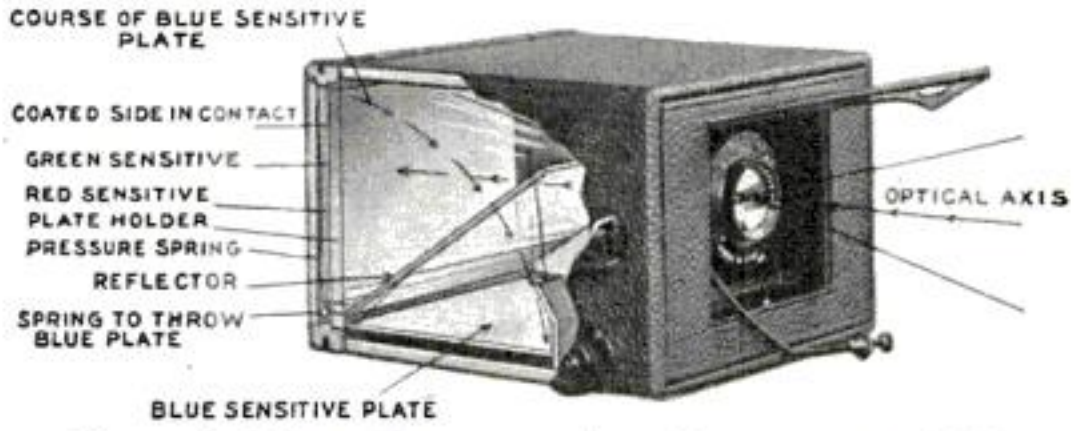
The appliance has a very delicate pump-regulating mechanism. A device for limiting the degrees of pressure within the lungs of the patient is combined with mechanism for controlling the supply of air—or of oxygen if oxygen is employed, as it may be. This minimizes the possibility of injury to the delicate structure of the lungs through abnormal pressures. A number of stops are located at different positions on the piston-rod. These serve to limit movement of the piston to be reciprocated. It is, of course, necessary to regulate the operation of the device so as to force much more air into the lungs of an adult person than would be used in the case of a child.

A limiting valve is interposed in a tube that leads from the inspiration cylinder or pump to the mouthpiece applied to the patient. This limiting valve regulates the amount of air or oxygen delivered to the mouthpiece and thus protects the patient's lungs against pressure of the air from the machine. This feature of the device is important because of the hurry and confusion that is likely to exist where a patient has collapsed. It may be noted in concluding that the device can be operated in a rocking boat, a swaying ambulance, or while the patient is being carried on a stretcher. An oxygen generator can be connected with the machine when needed.

Is This Actual Color Photography at Last?

SINCE the discovery of the wonders of the camera a hundred years ago, the instrument has done some marvelous work, but it has always been regarded as incomplete in that it was not capable of producing a print in which the colors of nature would appear. Some few years ago the greatest step in this direction was made by Frederick E. Ives, of Philadelphia, who succeeded in getting three impressions on glass and, when superposed and backed by a light, these three, each of a different color, blended together so that all the tints of nature were reproduced accurately. This trio could be placed in a lantern and the picture projected in all its glory of color on the screen. Utilizing the same principle it was found possible to make excellent press prints in color, but a photographic print in color was not achieved until recently, when Mr. Ives succeeded in devising a new camera by which it is possible to deliver a picture, entirely the product of the camera, in which are shown all the tints and colors of the original object or model.

The invention consists primarily of an arrangement by which three plates are exposed in the camera at the same instant and each one under a screen which sifts out all the rays except those desired. For instance, one plate takes a record of all the yellow rays, another the red rays and the third the blue rays. These plates are developed in the same manner as the usual photographic plates (differing only in the fact that they are extremely sensitive to color); then a print is made from each negative, a special printing frame being resorted to by which the three prints are made simultaneously. One of these prints is made on a piece of blue print paper, and the other two are made on film which has been sensitized with bichromate of potash, which makes an image slightly in relief. The film which was made under a red screen is dyed red and that which was made under the yellow screen is dyed yellow and then the three are held together, with the blue print on the bottom. When they are properly registered the colors are blended together and a perfect picture in real color is presented. After being secured at one edge, these sheets are given a chemical bath and then pressed together so that they form one piece. The process is no more complex than that of making an ordinary photograph. There are a few more operations which are more than compensated for by the beautiful results obtained.



The principles of construction of a camera which exposes three plates simultaneously. From them a photograph in natural colors can be made

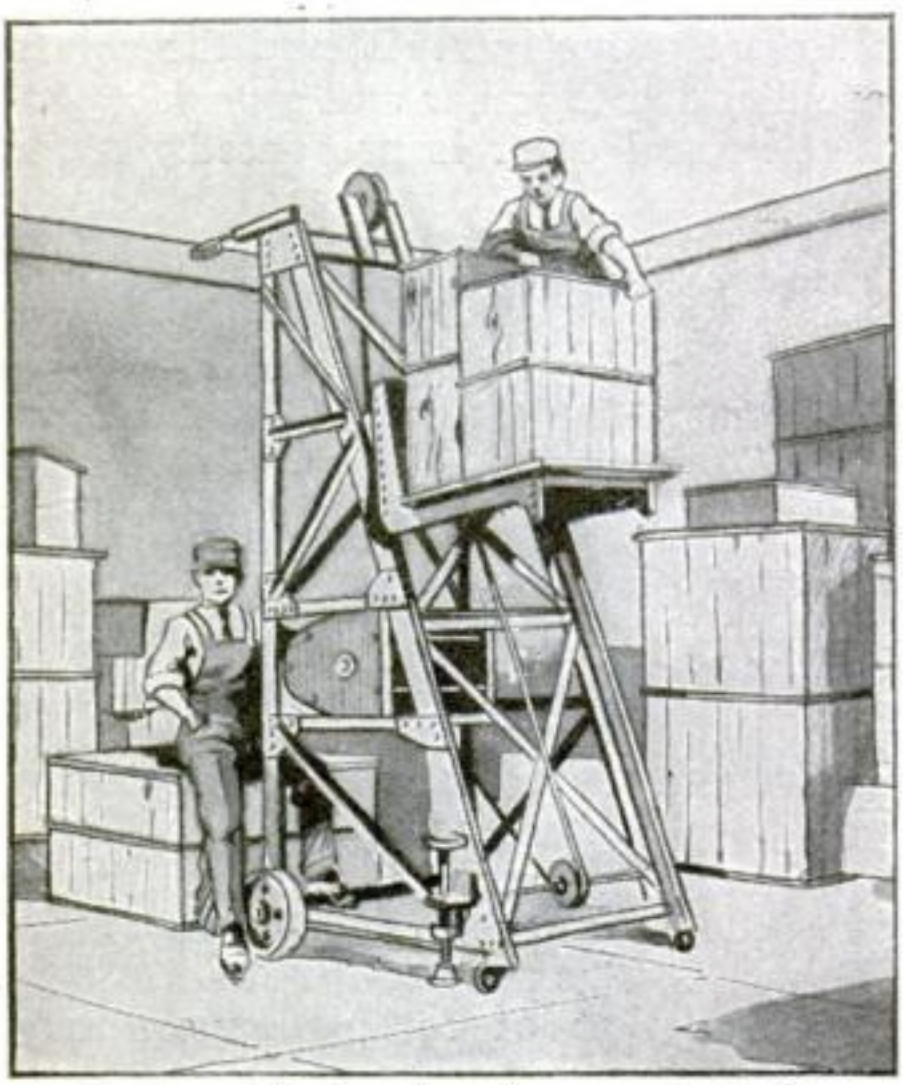
A Brazilian Snake Farm

ONE of the queerest farms in the world is the snake farm at Butantan, in the State of Sao Paulo, Brazil, where thousands of poisonous snakes of all varieties are kept in captivity. The venom is removed from these reptiles and injected into the veins of a number of young horses kept for that purpose. Thousands of tubes of serum are distributed from this institution every year, and much has been done to reduce the high mortality rate resulting from snakebites.

If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish, free of charge, names of manufacturers of devices described and illustrated.

A Movable Storehouse Elevator

IN many industries which require the storage and removal of heavy bales, boxes or casks the employment of stationary elevators is impracticable. This is the case in tobacco warehouses, in chemical factories and in storehouses for various raw materials, contained in packages half a ton in weight and a cubic yard in bulk, must be handled. As the bales are usually piled up four deep, the work of storage, if done by hand labor, is very fatiguing.



Boxes and bales for storage are easily handled by two men with this simple movable elevator

The *Zeitschrift des Vereins deutscher Ingenieure* says that a movable elevator has been devised by W. Dahlheim, which has given satisfaction in the establishments that have already adopted it. The apparatus consists of a wrought-iron skeleton tower having an inclined front, which forms the runway for the platform on which the load is placed. The loaded platform is hoisted by means of a hand-winch, so constructed that the platform remains stationary when the handle is released and descends gently with uniform speed when the handle is pressed backward. There are no separate brakes or catches to operate and everything is done with the winch handle. The work is so light that one man can raise an average load of 500 pounds to a height of twelve feet in one minute.

The elevator is mounted on two large wheels, at the back, and two small steering wheels in front. When it is to be moved to a distant part of the establishment, it is tipped backward on its large wheels and moved like a hand truck. The loaded elevator can be tipped without disturbing the load and can be moved through low doorways, while its small width (about thirty inches), allows it to traverse narrow passages. The vertical back of the elevator may be constructed in the form of a ladder, by which the pile of goods can be climbed. The floor of the platform is composed of a smooth iron plate, for bales, or a number of small rollers, for boxes. It can be loaded and unloaded either from the front or the side.

The field of this device is not restricted to storehouses. It may be utilized in the erection of buildings, for loading heavy articles on trucks or railway cars, and in various other ways. Its economy in operation is evident from the fact that for average loads it requires the service of only three men—one to load, one to unload, and one to hoist.

Why Do We Have Two Eyes?

BECAUSE we have two eyes the things we see seem solid and not flat, with the result that we can judge their distance from us with fair correctness. Look through a window at a house across the street with one eye closed and then with the other eye closed. The bars of the window frame will cut across the opposite house in different places. The two fields seen with the eyes separately although in the main alike, differ. When you look at the house with both eyes open the two fields seen by the two eyes are combined and the house across the street assumes depth and relief. Although we see a house with each eye we see only one house with both eyes. This makes the stereoscope possible—an instrument so designed that the two eyes are made to converge on a single point and yet to see two different pictures. If these two pictures represent a chair as it would appear to the right and left eyes respectively, they are perceived as one solid object.

Why Is the Sky Blue?

Sunlight, which we call white, is composed of light rays of different colors—red, orange, yellow, green, blue, indigo and violet. It can be broken up into its constituent colors in various ways. If it passes through a transparent prism (like the crystals that hang from a chandelier) or if it falls on a surface which has almost invisibly minute irregularities (like mother-of-pearl or the wing of a butterfly) we see the rays into which sunlight has been separated. These phenomena are observed when light is not absorbed.

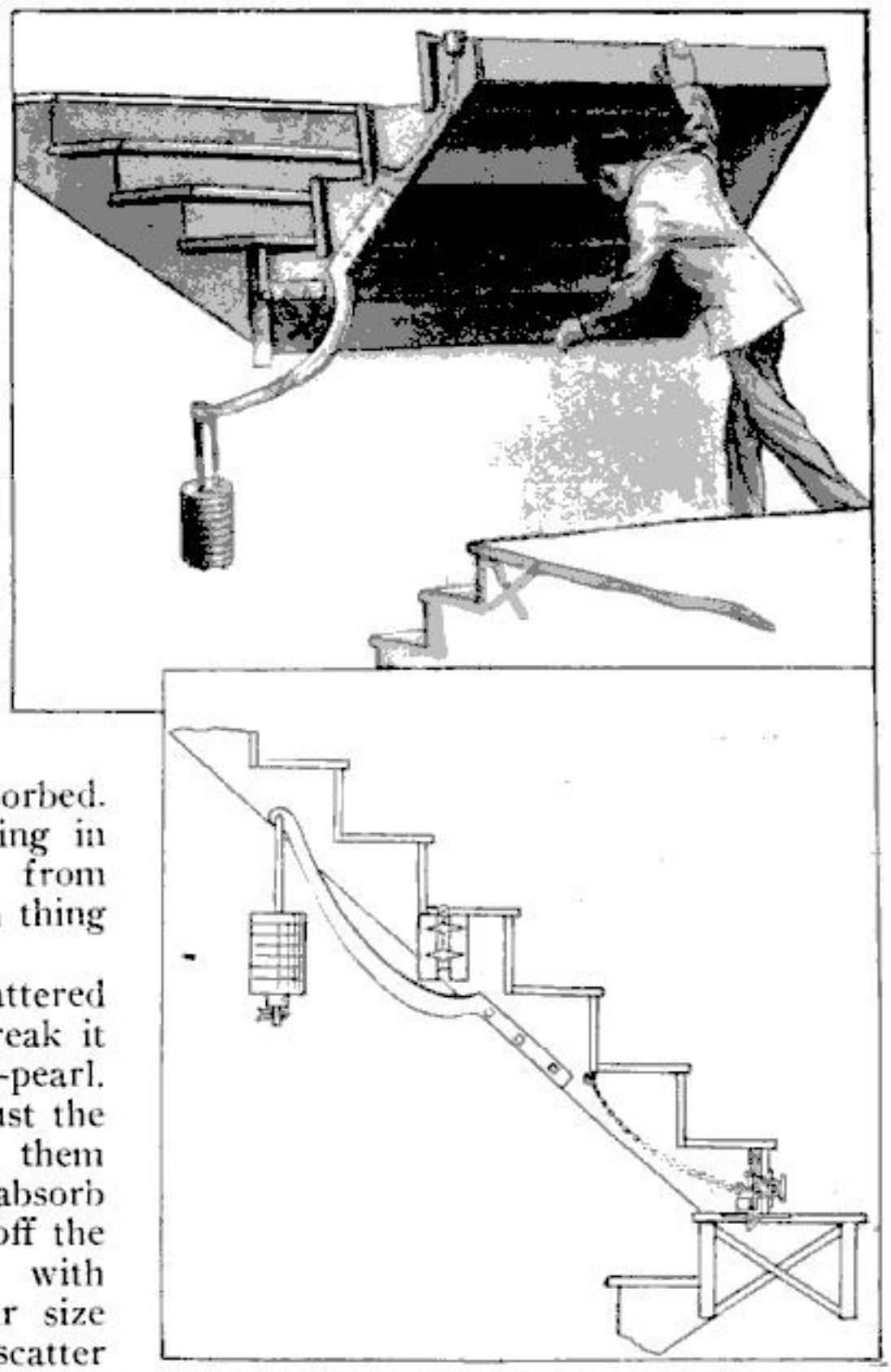
Hold a piece of red glass in front of a flame and we see only red. Rays of all other colors have been absorbed. The natural colors of the objects we see about us, leaves, flowers, books and chairs, depend upon absorption. A green leaf throws back chiefly green rays; the rest are absorbed. So, the natural color of everything in nature is the unabsorbed residue from full white light. There is no such thing as color by itself.

A swarm of minute particles, scattered in the path of white light, will break it up, like the surface of mother-of-pearl. If the particles happen to be of just the right size and the spaces between them just the right distance, they will absorb rays of one color only and throw off the rest. The atmosphere is filled with countless dust particles, and their size and spacing is such that they scatter rays which we call sky blue. Nearer the horizon, larger particles turn the blue into white; this happens above a dusty town and when mists or clouds hang above us. All that is left of white sunlight, after passing through many miles of blue-scattering air, appears in the hues of sunset. The size and spacing of dust particles as well as the angle at which sunlight strikes them, determines the color of the sky.

On the moon where there is no atmosphere and no dust, the sky is jet black at noon. The sun appears as a vividly glowing disk in an inky canopy. That is also true of the vast space which exists between the stars.

A Stairway Which Is Also a Door

IN order to construct a stairway between floors in a limited space, a swinging stairway has been developed which does away with the usual double-



A stairway which has a hinged door section, by which the cellar or the upper floor can be reached with equal facility

width landing. The stairs are built with a hinge half way between the upper floor and the landing, the landing being half way between floors. The stairs from the landing to the floor are built directly beneath the others. A person descending, stops at the landing to disengage a small catch. The released catch allows the lower portion of the hinged stairs to fold upwards, so that the person passes underneath them to the lower staircase. A heavy weight makes it easy to lift the stairs when the catch is released.

The tea-wagon has now been adapted to the kitchen. The dinner dishes are all handled at the same time

A Folding Service-Wagon

A REAL labor-saver for the housekeeper is a wheeled service-wagon. A helpful new one has two oblong trays with raised rims to prevent dishes from sliding off. The upper one is approximately table height, the lower forms a supplementary shelf beneath. In one trip, breakfast or luncheon for the family can be taken to the dining-room.

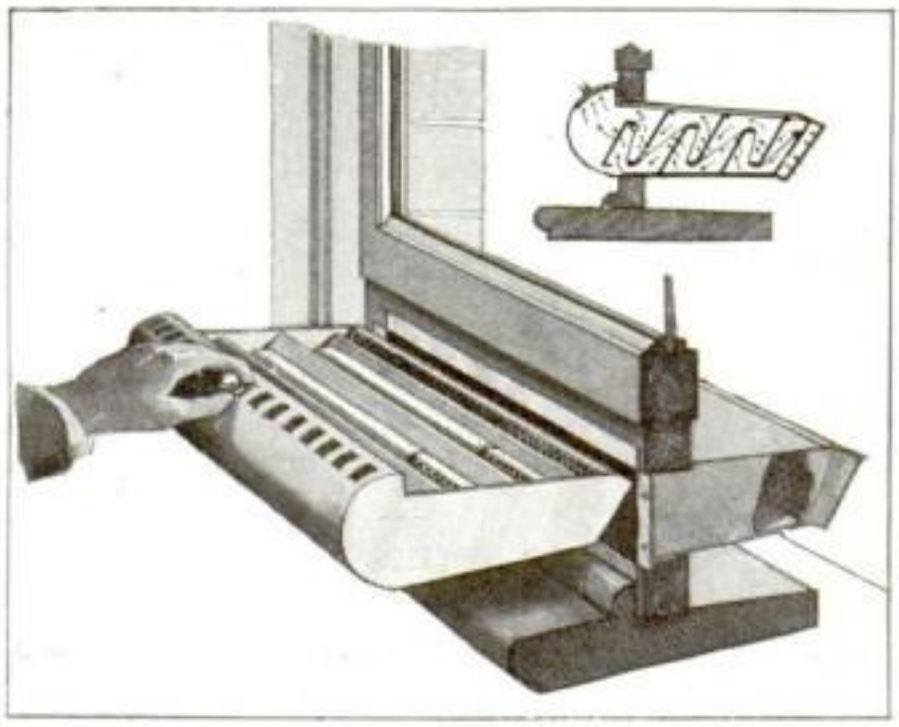
The wagon is mounted upon two large rubber-tired wheels with two small nickel-plated ones in the rear. Placed beside the wife at the dining table, it can be used without rising to exchange the soiled dishes of the first course for the fresh food of the second. After the meal the soiled dishes are wheeled in one trip to the kitchen. Rolled close to the sink, the wagon receives the clean dishes as dried and returns them to the china-closet. When not in use it folds up compactly and can be stored in a closet or pantry. It is equally serviceable to receive clean ironed clothes and to distribute them over the house, or to serve as a sewing and mending table.

A Dust-Collecting Window-Ventilator

IN order that the air brought into a room for ventilating purposes shall be as free as possible from dust, a filtering box has been developed, which, attached to the window frame, allows only cleansed air to enter. The box projects some distance beyond the outside wall, so that the air currents will be sufficiently strong to force their way through the layers of filtering material, into the room.

Sheet metal walls are arranged in the box in a zig-zag fashion, half of them attached to the top and half to the bottom; the air must pass repeatedly up and down. The walls are perforated at their outer edges. A strip of cloth is passed between the projecting edges of the plates. Because of the staggered arrangement of the plates, this ventilator acts in the incidental capacity of a sound muffler. When in position it occupies a very small space; and the amount of air admitted can be controlled by a small sliding shutter.

OF the two hundred and four cities in the United States of over thirty thousand inhabitants, one hundred and fifty-five have municipally owned water-supply systems, the total value of which is one billion, seventy-one million dollars.



A window ventilator which eliminates dust as well as drafts

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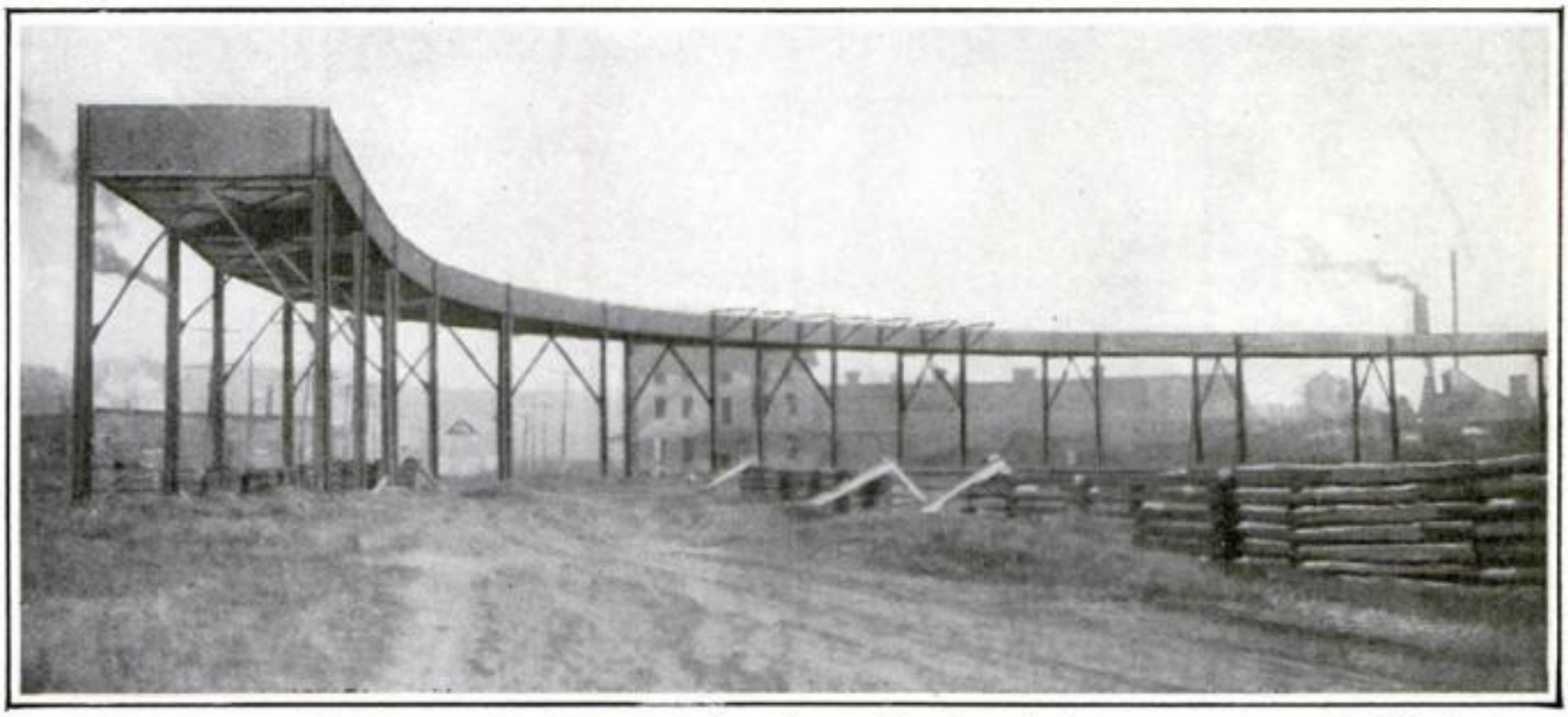
An Elevated Road Which Tried to Outstrip a Town

INTERESTING bits of history sometimes lie behind big projects—the motives that inspired the undertakings, the difficulties that were encountered in the promotion of the work and various other things that either record success or failure.

In Sioux City in 1890 was built the third elevated railway in the United States. Also Sioux City is said by many to have had the first electrical elevated railroad in the United States.



What remains in Sioux City, Iowa, of the elevated railroad that cost more to build than the suburb it served was worth. The railroad actually ran during the "boom" days of the 80's, but Sioux City, with thirty thousand inhabitants, finally decided she did not need it

It was not necessity that prompted the building of an elevated railway in Sioux City; it was the desire to develop farm land into a suburb of what was destined some day to be the great commercial center of the west. The company collapsed a few years later, but endured long enough to accomplish its one aim—to convert a strip of farm land into a suburb.

In reality Sioux City grew during the years of 1880 and 1893 to a size far out of proportion to the development of its trade territory. The slogan appeared to be: "Build the city first!" instead of permitting the city to expand as the industries of agriculture and cattle-raising expanded.

Sioux City was in the midst of a "boom" between the years of 1880 and 1893. Buildings sprang up within a night. The elevated railroad was one of the "boom" products. Like other projects it fell during the panic of 1893. But unlike numerous other undertakings of magnitude it was not abandoned after the crash, which blighted the dreams of hundreds of men, although at that time it went into the hands of a receiver.

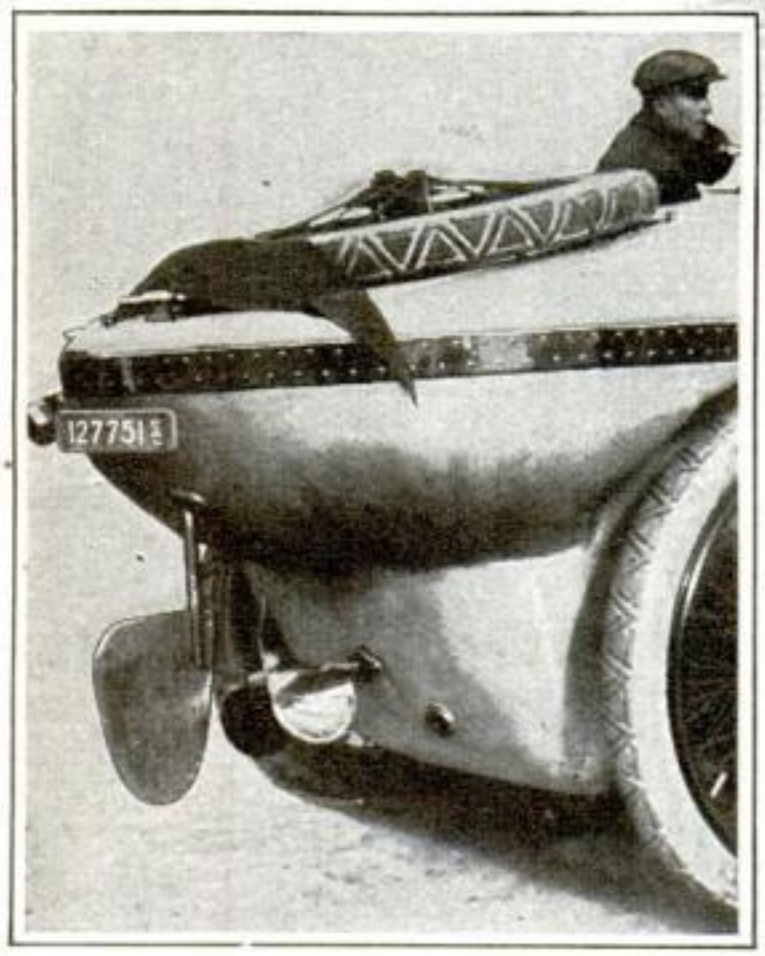
The men who built it believed, of course, that it would be used permanently. The suburb could have been reached as well by surface lines as now—but the purpose was to shorten the distance by building an elevated line which would obviate all railroad crossings.

The elevated road, proper, was about two miles in length. To this was added about three miles of surface lines. The cost of construction for the five miles of railway was $586,000.

On December 7, 1889, the contract for construction work was awarded. Finished within a period of six months, it was used as a steam road until May 5, 1893, when one of the builders and incorporators was appointed receiver. No reverses of importance were experienced by those who financed the work or the construction company. In the rush everything apparently was forgotten. When the panic was precipitated the bonding companies realized their mistake. There had been no demand for such a road in a city that contained only about thirty thousand inhabitants.

Delia the Motor Duck

THOUSANDS of bathers at a famous beach near San Francisco were recently astonished to see a rakish-looking automobile drive down the beach and into the water. Instead of immediately disappearing beneath the waves, the automoble rode high over the swells, and still moving rapidly, took a short cruise around the harbor, after which it came ashore and disappeared as suddenly as it had appeared.



If you owned "Delia" and you came to a stream you would plunge boldly in and swim with the aid of the propeller to the opposite shore. Then you would climb the bank and ride on wheels over roads again

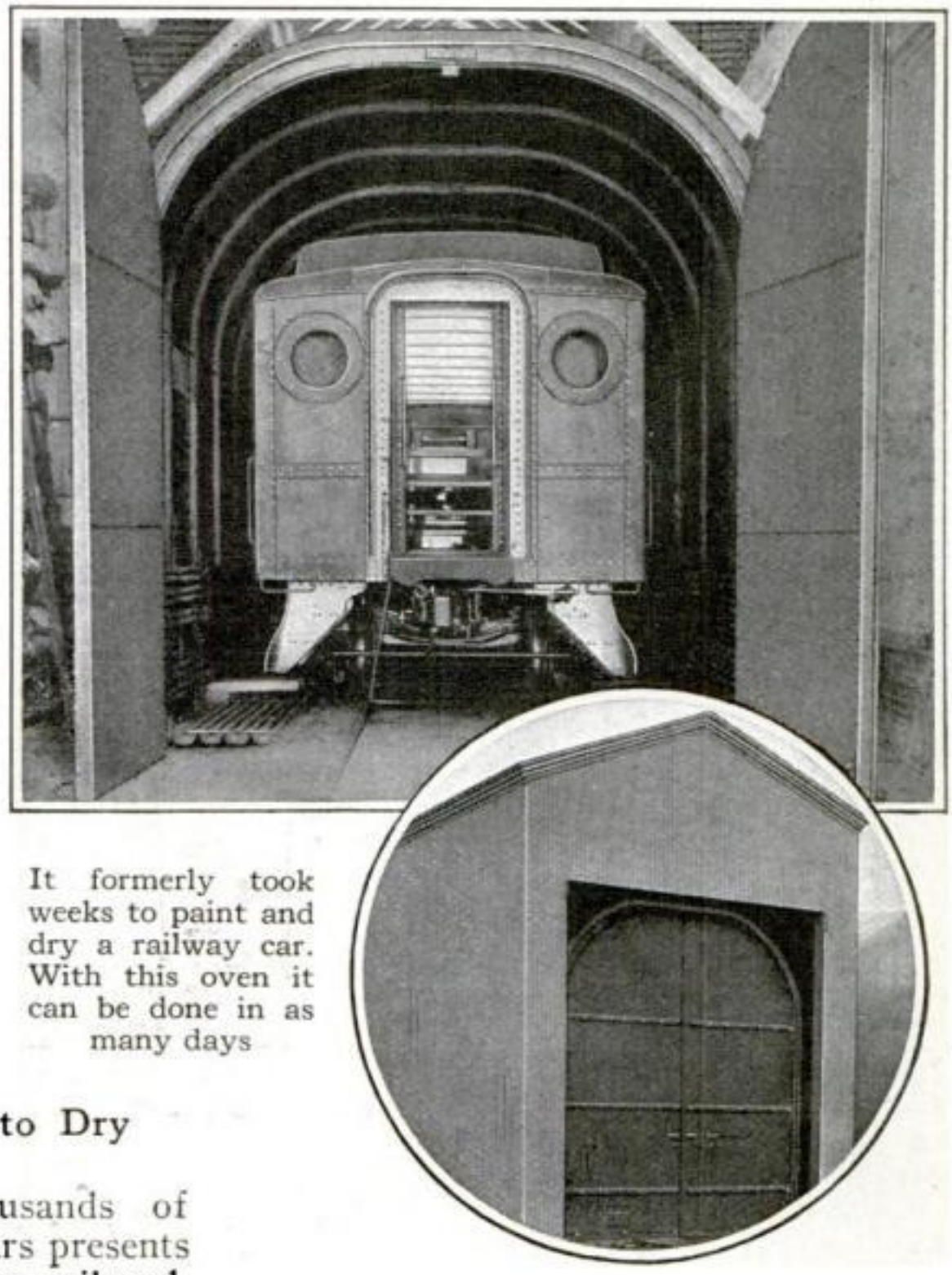
A closer inspection of this remarkable machine reveals the fact that it has a boat body, through which project the automobile wheels. When used as a boat the power is transferred from the driving wheels to a propeller in the stern, and the steering wheel actuates the rudder instead of the front wheels.

Water is prevented from entering the body at the points where the axles pro-

ject through the sides by the same method of packing that is ordinarily used at the propeller shaft. The hull, or body, is hung on large steel springs, similar to those used on stock automobile bodies. These springs, as may be seen in the illustrations, are not exposed, but are contained within the hull with the rest of the mechanism, and are protected from all dust, grit and water. The sides of the boat-automobile are high enough to prevent the shipping of water, but the machine is not designed to be operated in rough weather.

The hydro-motor car rides well in the water, and is able to attain a speed of about ten miles an hour.

This hydro-motor has proved so successful that its inventor, Michael de Cosmo, of San Francisco, is designing a new model which he expects to exhibit in the near future. Several improvements suggested during the experiments with Delia," will be made soon.



It formerly took weeks to paint and dry a railway car. With this oven it can be done in as many days

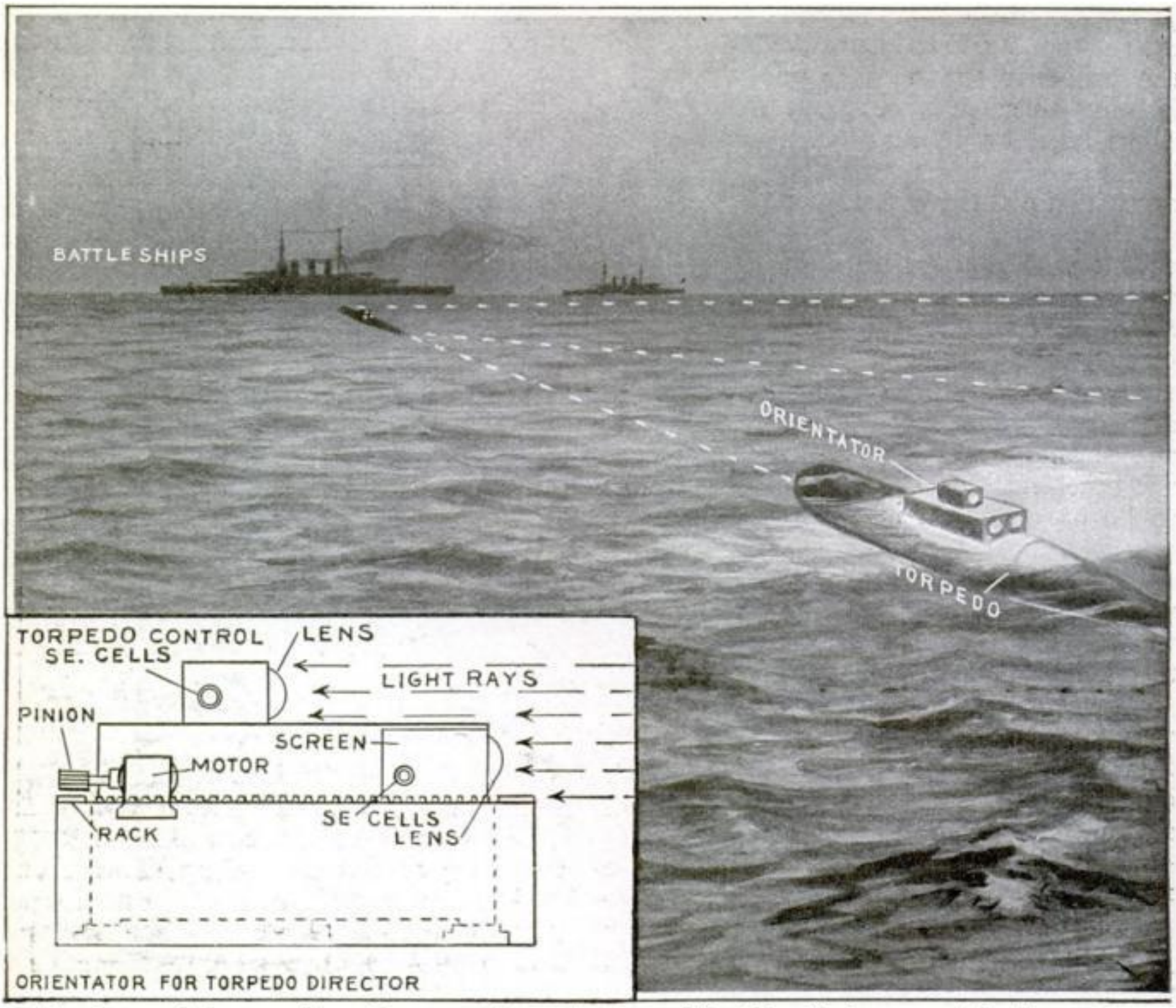
Baking a Railroad Car to Dry the Paint

THE repainting of thousands of passenger and freight cars presents a big problem for the average railroad. It also represents a large expense, which the roads are trying to cut down by increasing the durability of the paints and shortening the time that cars must be kept out of service during the process. It is the aim of practically every road to keep its cars in continual use, whereever possible.

Very recently the Pennsylvania Railroad established a test department, for the purpose of speeding up the work of inspection and repairs and thereby reducing the loss due to idle cars. One problem that had engaged the attention of the railroad officials was that of reducing the time required for drying a car after painting. Their experience, however, with quick-drying paints had not been satisfactory, as they proved less durable than those requiring two days or more to dry.

This led to experiments in baking the slow-drying paints, and for that purpose the railroad recently constructed a mammoth baking oven at Altoona, Pa. It is large enough to accommodate cars of almost any length. With the car well inside, the doors are closed and the temperature is raised above the boiling point of water. The paint is completely dry and hard and the car ready for service in about three hours.

The saving of time by this process has been very marked. It has reduced by ninety-five per cent. the time usually required for drying cars by the old method and has cut in half the time a car is held out of service during repainting. Besides, the artifically dried paint is claimed to be much more durable than that dried in the open air.



As a human being, you have the power of running toward the thing that you see. You have eyes —organs sensitive to light. Suppose a torpedo had eyes. Suppose that it were given the power

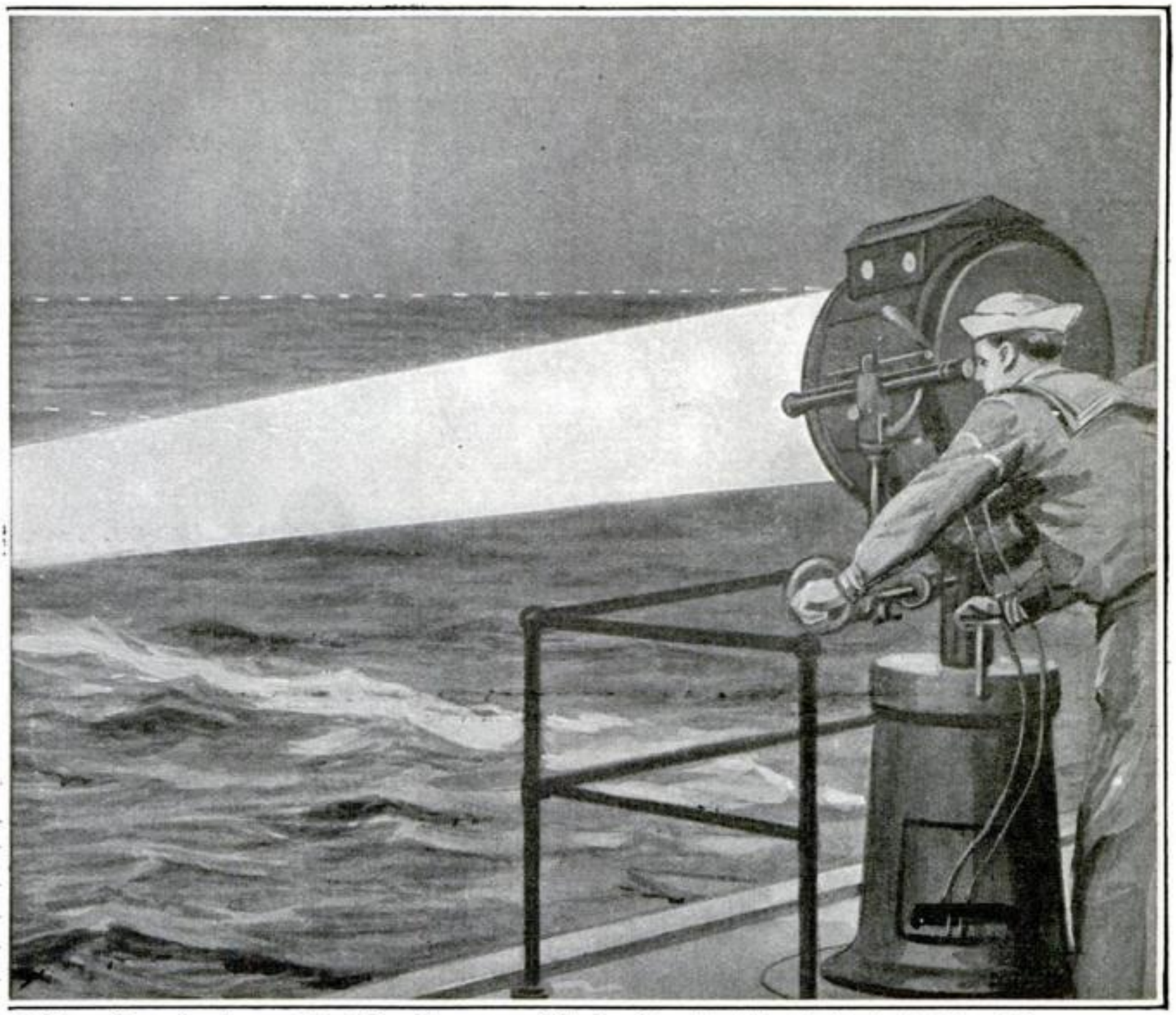
A Torpedo with Eyes

By Walter Bannard

SUPPOSE we have at our command torpedoes that obey the orders of a single master; torpedoes that heed faithfully the wish of an operator expressed through a simple directing apparatus; torpedoes that can be projected six or eight miles through the water, being constantly under the control of the man and his machine on shore; in a word, torpedoes which carry out the intention of one man to destroy an oncoming vessel of the enemy. This torpedo would simply be the projection mechanically, of this man's will to destroy that vessel.

Theoretically, we have the materials at hand to render this achievement possible. In fact, the "light-directed torpedo," as it is called, is virtually on the threshold of reality, but it has not yet crossed the threshold. This delay is caused by the present unreliability of a chemical substance, selenium, and it is upon selenium that the eventual success of the light-directed torpedo depends. In an article on the Hammond electric dog, appearing elsewhere in this issue, will be found an explanation of the way in which selenium does the work.

A boat has been directed wirelessly from shore—most all of us have read of that—and a boat can be directed by wire-



either of running toward the thing it sees, or of fleeing from it. That is the basic idea of the weapon here pictured. Its movements are absolutely controlled by the beam that comes from a searchlight

less from shore now; can be made to stop, start, stop and swerve to right and left. Nevertheless, the secret of a reliable, light-controlled torpedo — for light-rays are more desirable than wireless—has not yet been entirely solved.

John Hayes Hammond, Jr., who has been widely heralded for his wireless experiments, joined hands not long ago with B. F. Meissner, an electrical engineering student of Purdue University, and together they designed and constructed an ingenious mechanism on wheels that would trail after a pocket lamp held before its selenium eyes in a most uncanny way. Using this same principle, a torpedo with selenium eyes that will follow the directions of light rays from shore, will eventually be developed; soon, it is to be hoped.

There have been two big obstacles to prevent the evolution of a controllable torpedo:

One is the lack of a suitable apparatus for transmitting sufficient light to control the mechanism at useful distances; the other is to accomplish the directing without interference from the enemy's ship. The solution of the problem demands a more scientific knowledge of selenium and its chemical properties.

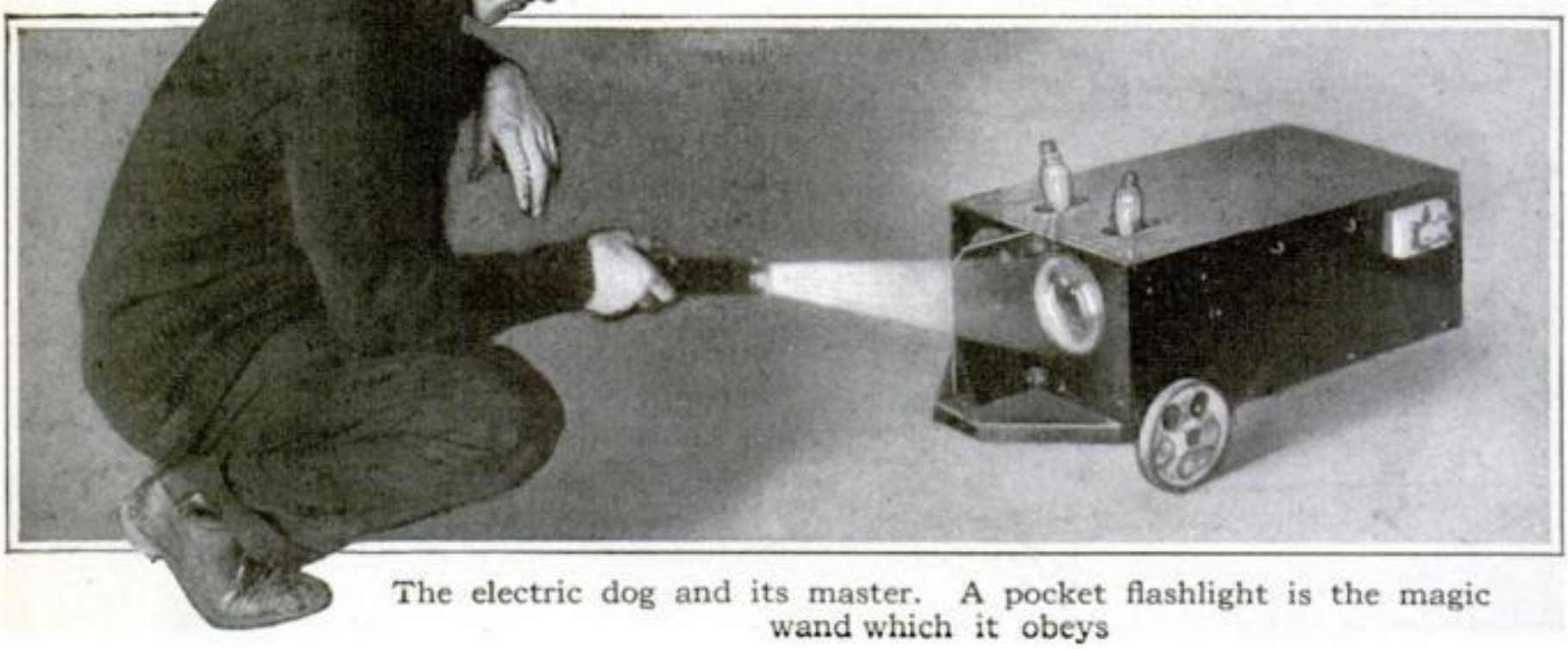
Suppose that day had come and a hostile ship was booming into the harbor of New York, grimly determined to scatter our fair buildings to the four winds.

"Sic!" says the man on shore.

Almost with human intelligence, the glistening steel cylinder darts out towards the enemy, at a forty-mile-an-hour clip. Though at present such an occurrence is only a fancy, it may become a reality.

The Electric Dog and How He Obeys His Flashlamp Master

By B. F. Meissner



The electric dog and its master. A pocket flashlight is the magic wand which it obeys

THE electrical dog, which Mr. John Hays Hammond, Jr., and I designed, and which has received much publicity, has no tail to wag and no voice to bark with, but he can follow a person about in a most surprising way.

Like the sunflower that follows the sun in its path across the heavens, my first apparatus was capable of turning itself only to face the object that stimulated it. But a great difficulty had to be overcome. The stimulant was light, and sometimes the dog saw too much light, so that he behaved occasionally in an astonishingly erratic manner.

Just how grave a difficulty this disobedience really is, was illustrated by an amusing incident during a demonstration at a Chicago theater.

The dog was ready to spring into action, but when the stage was lighted, instead of obeying the flashlight held in my hands, the dog insisted on paying attention to a very alluring but not thickly clothed young woman painted on the scenery near by. It seems that the reflected light from the painting was sufficiently brilliant to compete with the flashlight and to cause the dog to creep to this fairer attraction with a directness which was almost uncanny.

To all practical intents and purposes, the electrical dog is a dead dog until excited by an external light ray—usually a pocket flashlight, held in the hand. Fastened to the front of a squat, oblong box on three roller-like wheels, are two great lenses, much out of proportion to the rest of the dog's make-up. These are the eyes through which the dog receives his intelligence. Behind the lenses are two extremely sensitive cells containing the black, wax-like selenium. Because of the importance of this substance in the dog's behavior, the mechanical animal has received its nick-name, "Seleno." A peculiarity of selenium is that it is sensitive only to light rays; or, to put the facts a little more technically, selenium is a non-conductor of electric currents until it is struck by light, when it becomes a conductor. Located behind the selenium eyes is an arrangement of relays, batteries, magnets and a motor. When a beam of light strikes one of the selenium cells, it causes a relay to be operated which, in turn, causes current to flow through one of the magnets controlling the steering wheel. The driving motor starts, and the dog is under way. Shift the light so that it strikes the other selenium eye and the dog moves in the other direction. In other words, in whichever direction the light travels, there, also,

will the dog go. By reversing a switch on the outside of the box, the dog can be made to back away from the light. Illuminating both cells equally causes the dog to move in a straight line.

The electrical dog will never become a common household toy. It has taken years of scientific study and endeavor to perfect, and it requires ripe technical knowledge to understand clearly. However, for the benefit of the reader who possesses more than an average amount of scientific and technical knowledge, a detailed description of the electrial dog is given in the following lines:

The mechanism involved in the successful performance of the electrical dog is so complicated and delicate in its nature that it is doubtful if many experimentors will care to attempt its construction. Few dimensions are given, because the materials naturally convenient to the builder have an important bearing upon even the most detailed parts of the apparatus. The dimensions, together with the construction in general, are largely a matter to be determined by the builder's individual ingenuity. The general construction details supplied here were embodied in the electrical dog, or orientation mechanism, that Mr. John Hays Hammond, Jr., and I constructed, and which I have employed in lectures and demonstrations before various engineering societies and gatherings of all kinds.

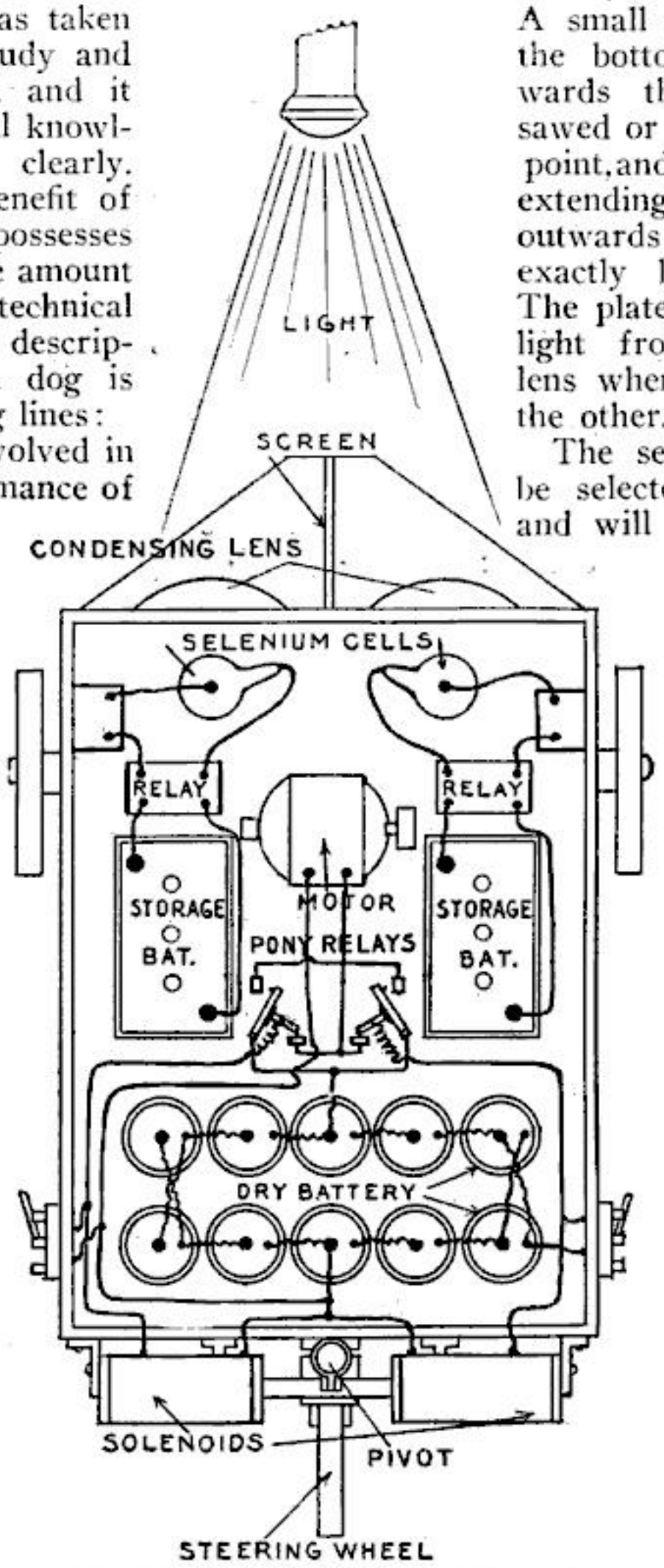


Diagram showing the electrical apparatus used in the construction of the Hammond Meissner Orientation Mechanism, or Electric Dog. Rays of light striking the selenium cells cause the motor and steering magnets to be operated. The light in the position here shown causes the dog to go in a straight line

Beginning outwardly, the electrical dog has these three dimensions: Length, three feet; height, one foot; width, one and one-half feet. A small shelf projects from the bottom of the box towards the front. This is sawed or whittled almost to a point, and a metal plate erected extending four or five inches outwards from a line drawn exactly between the lenses. The plate is there to prevent light from going into one lens when it is intended for the other.

The selenium cells should be selected with great care, and will cost from five dollars apiece, upwards. The cells are of as low a resistance as possible, this resistance being at the same time consistent with a high resistance ratio between light and darkness. Putting this thought into concrete figures, cells with a resistance of from one thousand to one hundred thousand ohms normal or "dark" resistance are the best. The resistance of the cell in the dark should be at least three times as great as its resistance in sunlight. I have used cells of sixty thousand ohms resistance, and they gave good results with batteries of fifteen or twenty dry cells. Since the current amounts to

only a few thousandths of an ampere, small flashlight batteries may be employed. The selenium cells should be capable of carrying at least two or three milli-amperes without heating.

The next and probably the most delicate step in the entire construction is the ultra-sensitive relay that is placed in circuit with each selenium cell. These should operate reliably on a change in current strength of as little as twenty-five millionths of one ampere.

The finest of polarized relays, such as those devised for use with coherers in the early stages of wireless telegraphy, require an operating current of at least five hundred microamperes, or one-half a milli-ampere; the most sensitive galvanometer relay with solid contacts requires about two hundred microamperes. These values are for conditions of jar and vibration such as those which naturally exist in the electrical dog. The relays that I use are the most sensitive of the pivoted, galvanometer type; but instead of having two solid contacts of platinum, one is made of platinum with a needle point, and the other is a globule of mercury, an arrangement which requires a very small contact pressure for reliable operation under vibration.

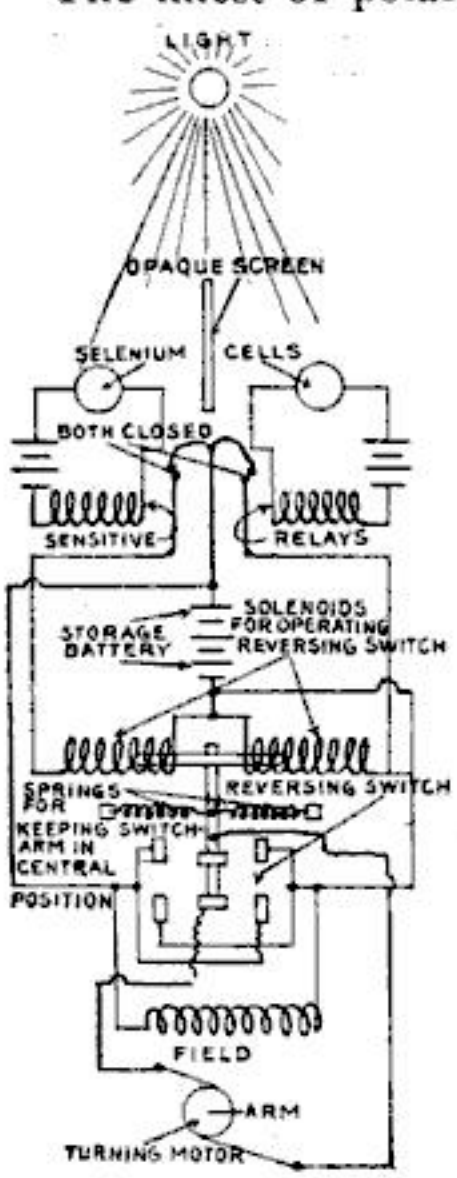


Diagram of the electrical connections

A drop of light oil over the mercury prevents oxidation. This contact, however, cannot break currents in excess of a few milliamperes and should therefore be used in conjunction with relays of the telegraph type, which are capable of handling the currents required in the motor and solenoid circuits. Less sensitive instruments cannot be used unless the source of light be very powerful. The sensitiveness of this arrangement is so high that a dog can be operated with ease from a distance of twenty feet with a pocket flashlight.

The pony relays indicated in the diagram are ordinary telegraph relays of twenty ohms resistance, provided with a special pair of back contacts, which are always closed when the relay is not energized.

The motor is a ten-volt battery motor of the largest size obtainable (about fifty watts). Its source of power should be a storage battery, which also supplies the solenoids. In my apparatus this battery was composed of four four-volt, thirty-ampere-hour cells. They should be as small and as light in weight as possible.

The solenoids are approximately five inches long and three inches in diameter, with cores three-fourths of an inch in diameter. Of the iron-clad type, they are wound with number sixteen magnet wire, and have cone-shaped pole faces, the air gap being inside the coil near the middle; the stroke is about one-half inch from the central position. Their purpose is to turn the steering wheel.

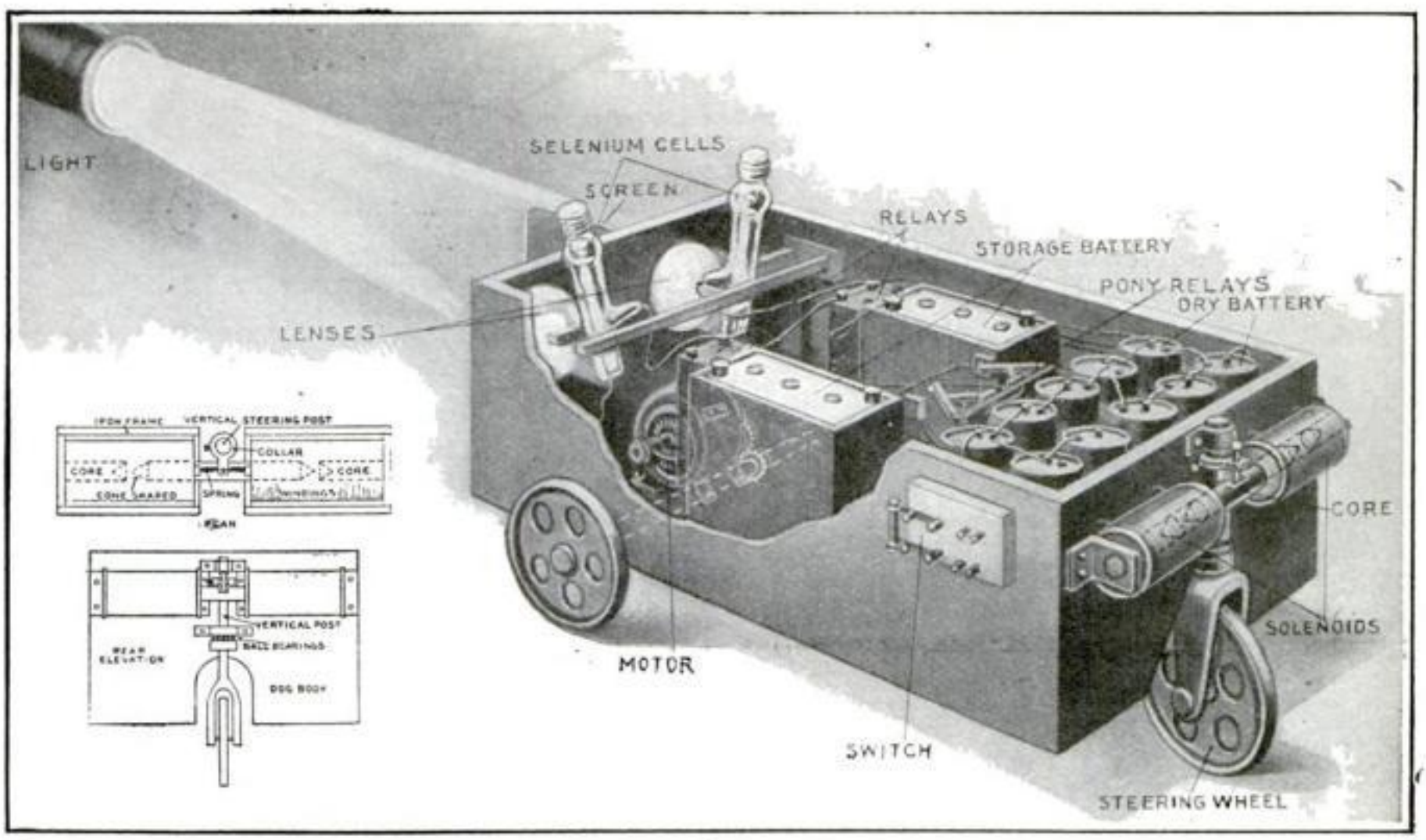
The core, which extends from one solenoid to the other, is maintained in the central position when both the solenoids are energized.

The single rear wheel is mounted on ball bearings in the horizontal plane to facilitate turning by the steering magnets.

The reversing switches, by means of which the dog can be made to back away from the light, instead of being attracted to it, are not shown in the diagrams as they would introduce an unnecessary amount of complication. Their purpose is to reverse the connections of the two solenoids.

The driving motor is connected to the shaft of the two forward wheels through a worm-wheel reduction, and a differential gear box, such as those on automobiles.

The adjustment of the parts of the dog is sometimes a rather difficult task, particularly when other sources of illumination besides the flashlight are encountered. If used in a room with windows through which daylight passes it

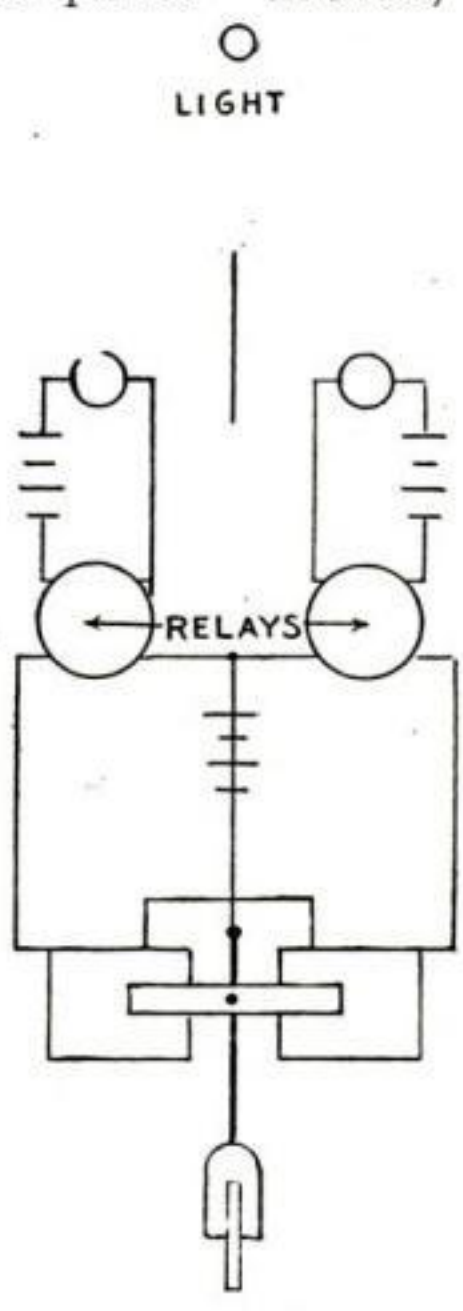


A perspective view of the dog showing his internal mechanism. In the insert, a diagram showing the construction of the steering solenoids

may suddenly refuse all the inducements offered by the master with his pocket flashlight and turn his entire attention to the pursuit of the window.

The principal adjustment is that of equal sensitiveness of both selenium-cell-relay units. It is practically impossible to obtain two selenium cells having equal resistances and equal sensitiveness, and therefore different applied voltages and different tensions in the back springs of the relays are necessary, in order that both will operate at the same instant when influenced by the attracting light, and that both will release at the same instant when the light is extinguished, or when it becomes too weak to effect operation.

With selenium cells made sensitive only to definite colors or wavelengths of light, it is possible to make the dog back away with one light and be attracted by another. Cells can be given a certain amount of inherent color sensitiveness, but this is best secured by means of ray filters which allow only definite wavelengths to pass. Another means of making the dog sensitive to only one source of light is to cause that light to be interrupted by means of some form of shutter, in conjunction with selective elements on the dog which will not allow the sensitive relays to be closed unless the fluctuations in the transmitted light correspond exactly with the frequency of the selective element.



A simplified diagram illustrating the principle of the dog's construction

It is obvious that if we make the dog a boat instead of a wheeled vehicle, and if we provide the boat with a forward compartment filled with gun cotton, we would have a torpedo of the kind described and pictured elsewhere in this issue. A searchlight on board a ship would serve to guide the torpedo on its course of destruction through the water.

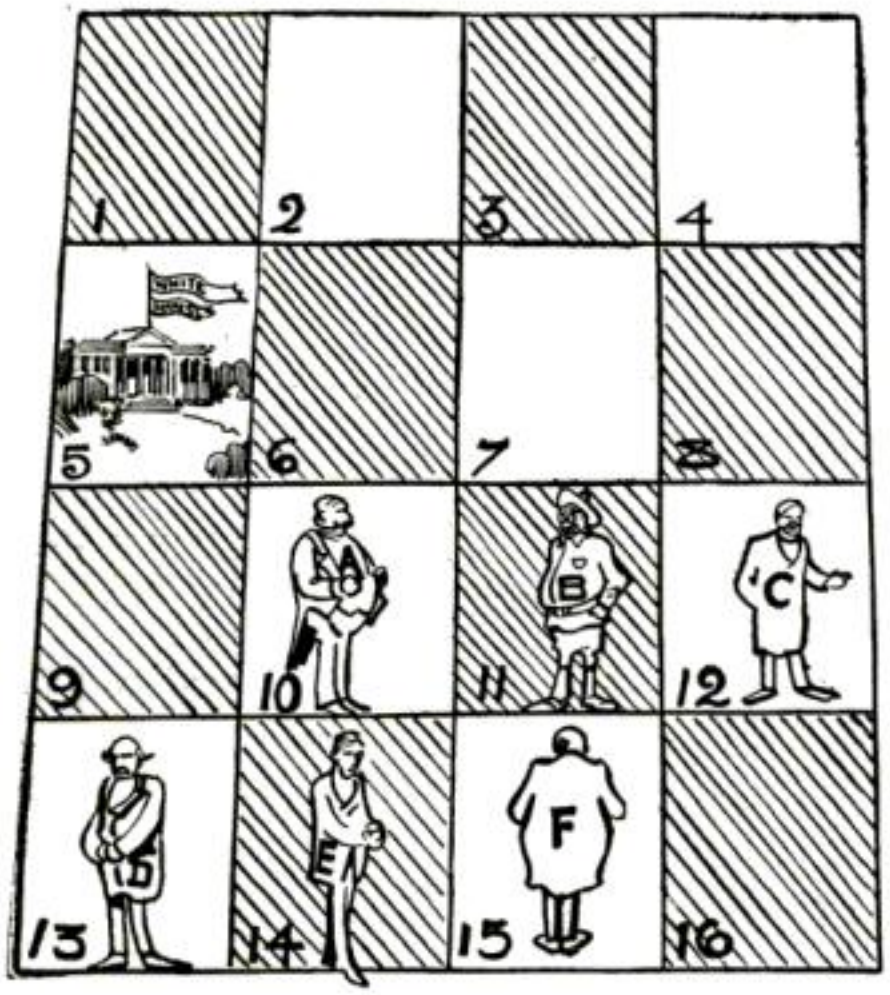
A Medley of Puzzles

By Sam Loyd

We asked the puzzle man to prepare for our readers a variety of his popular problems—mechanical, mathematical and otherwise.

Here we have his first offering.

Let us put on our thinking caps and see who can unravel his interesting posers.—Editor.



The problem of the presidential dark horse

The Presidential Puzzle

A political prophet says that only six of the presidential possibilities are to be considered in "the running," and that, eventually a "dark horse" will come in the winner.

In the illustration we see his idea presented in checker-board puzzle form, with the six likely candidates deployed for the contest and the "dark horse" standing on square No. 15. The puzzle is to show how the candidate F may, in a series of jumps, make his way to the White House on Square 5, his opponents being eliminated in the process. Here are the conditions:

Puzzling Kugelspiel (see page 431)

Jump the men in any order you wish, a jump meaning that a candidate hops over another on an adjoining square to the square beyond.

A candidate hopped over is at once removed from the field.

The jumps may be diagonal or otherwise. That part does not matter.

Start with anyone you like and continue the jumps until the survivor F in the final jump lands on Square 5, the president's future home.

The candidates and squares are numbered and lettered to facilitate a description of the jumps.

Now see if you can clear up the political situation.

Prizes for the Clever Ones

If you can solve one or more of the problems write out your answers and send by post not later than March tenth to SAM LOYD, care of the Popular Science Monthly, 239 Fourth Ave., New York City.

To each of the ten persons who send the best answers to the puzzles will be awarded a copy of Sam Loyd's Cyclopedia of 5000 Puzzles, Games, Tricks and Conundrums," published at Five dollars.

Answers and prize awards will appear in May issue

Puzzling Kugelspiel

An old Dutch sportsman informs me that our modern ten-pin game is derived from the Dutch pastime of Kugelspiel, played on the greens of Holland for many centuries. He says that while our modern game has resolved itself into mere expertness in knocking down the pins many variations of old Kugelspiel involved mathematical features as well.

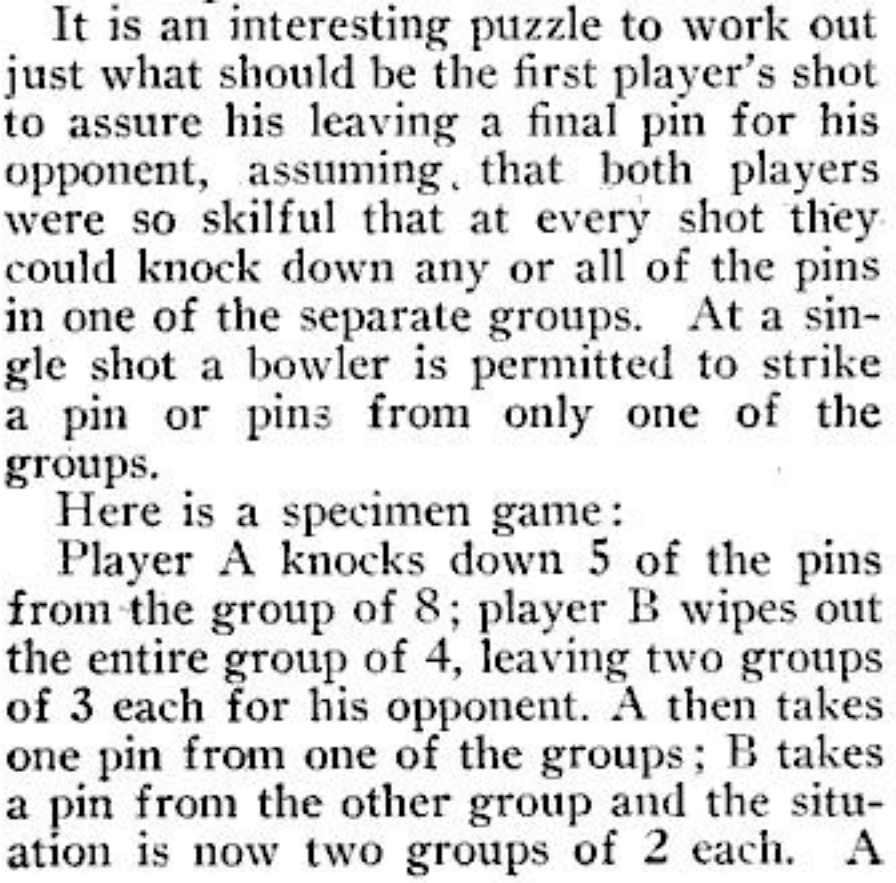
The most scientific of these old-time "set-ups" employed 15 pins which were arranged, as shown on page 430, in three groups of 3, 4 and 8 pins respectively, and the contest between two players consisted in turn-about plays to see which would be compelled to roll his ball at the final pin.

It is an interesting puzzle to work out just what should be the first player's shot to assure his leaving a final pin for his opponent, assuming that both players were so skilful that at every shot they could knock down any or all of the pins in one of the separate groups. At a single shot a bowler is permitted to strike a pin or pins from only one of the groups.

Here is a specimen game:

Player A knocks down 5 of the pins from the group of 8; player B wipes out the entire group of 4, leaving two groups of 3 each for his opponent. A then takes one pin from one of the groups; B takes a pin from the other group and the situation is now two groups of 2 each. A takes one pin then B removes the 2 and wins by leaving a single pin.

If you were bowling a game with the old Dutchman what would be your opening shot in order to assure the leaving of a final pin for him?



The Cost of a Villa

The Cost of a Villa

When the Smith's suburban villa was completed and they counted costs, it appeared that the painter's bill was $82 in excess of the paperhanger's charges; the plumber charged $30 more than the painter; the mason received $160 more than the plumber and the carpenter, who charged $24 more than the mason, rendered a bill three times as large as that of the paperhanger. The lot cost half as much as the house, so who can tell how much the Smith's new home cost?

An elephant on his hands

An Elephant on His Hands

An overly-ambitious Hindu who had acquired the proverbial elephant that "ate all night and ate all day," sought to rid himself of the voracious beast by unloading him on a fellow native. The prospective buyer was willing to do business on the basis of 8 rupees less than the asking price; the would-be seller would knock off only 20 per cent. There remained a difference of 7 rupees between their terms, and the pachyderm failed to change owners.

Can you tell how much the native was offered for his animal?

How to Ascertain Your Latitude and Longitude

By Hereward Carrington

THERE is a very simple way by means of which the novice, untrained in astronomical observation, can determine his latitude, without the aid of complicated and expensive apparatus.

If you were situated on the equator, the north star would be directly north of you. This star must be learned and identified, so that it can be picked out anywhere, at a moment's notice. This is all the astronomy you need know—as the location of this star will give the latitude.

When half-way to the north pole the north star is midway between the zenith and the northern horizon. At the pole it is directly overhead. In all other places its "angle" varies, being for example, 30° at New Orleans, 40° in Philadelphia, and so on. The altitude of the north star is the latitude of a place north of the equator. All that is necessary then, to determine the latitude, is to measure the angle of the north star and thus determine the altitude of the celestial pole. This will give the latitude.

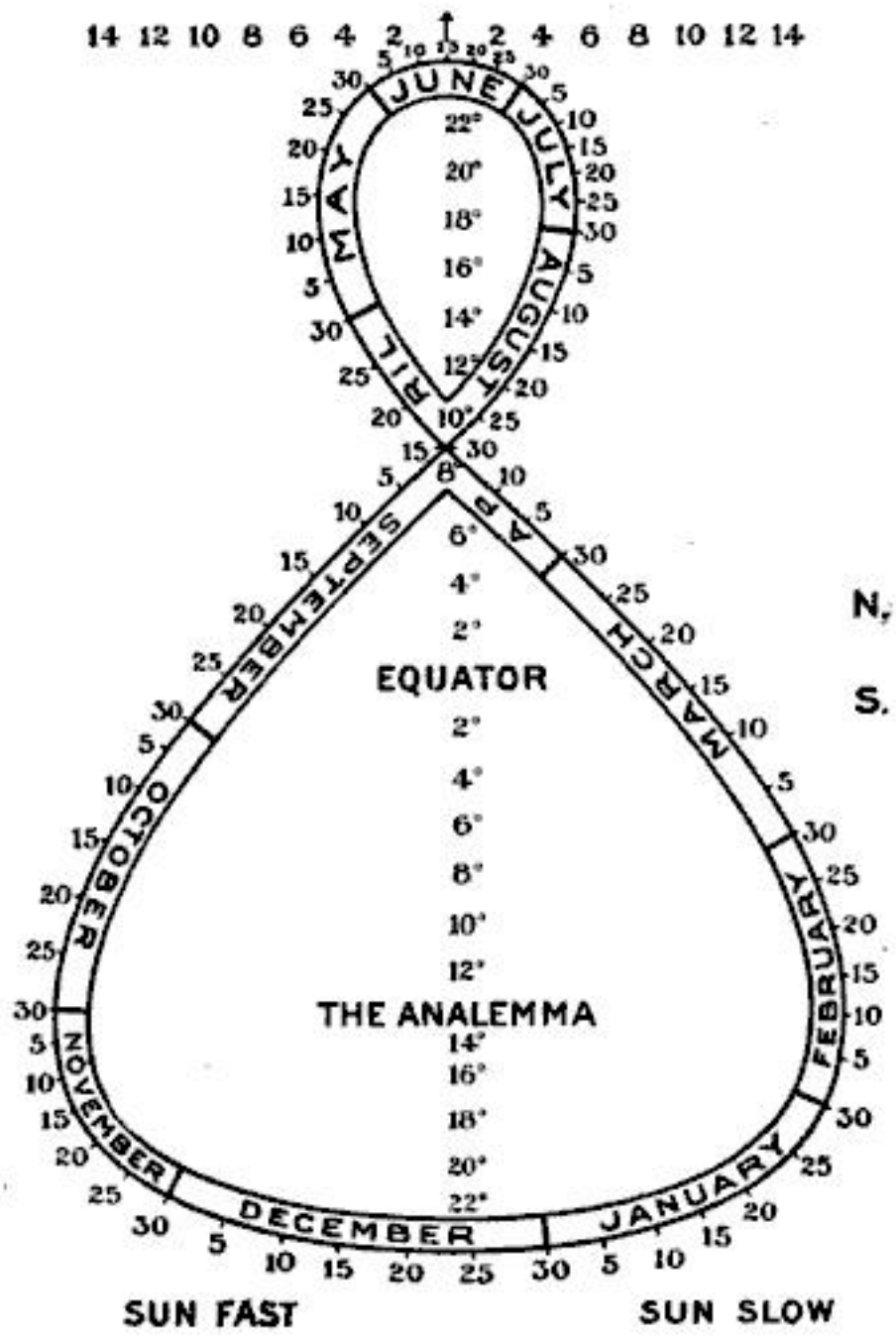
Take a pair of ordinary compasses. Open them, and place one point in a level window sill, holding the arm upright. Now point the other arm of the compass at the north polar star. The angle thus formed by the pair of compasses will be fairly accurate, provided the pointing has been done carefully and the other arm is held at right angles to the sill.

When the compasses have been adjusted, as explained, proceed to measure the angle formed by the arms of the compass. This will indicate your latitude. For every degree of curvature of the earth, the north star rises one degree from the horizon. It is thus an easy matter to see your latitude, from the number of degrees made by the angle of your compass.

Another way to discover the latitude of any given place—and a method much more often used—is by means of the sun. Observations of the sun are depended upon by vessels at sea.

The first thing to do is to ascertain what is known as your true north-south line. To do this you must know your longitude and have the correct time. Next, measure the altitude of the sun at apparent noon—that is, when its shadow is north. Place a curved piece of cardboard in the window, as shown in the diagram, with the blind drawn down to the wood of the upper window. The angle made by the shadow will then indicate the altitude of the sun with sufficient accuracy.

Next, consult what is known as the "Analemma" (see diagram). If you live in the northern hemisphere, you must subtract from the declination of the sun (which the analemma gives you) the sun's declination. Subtract this result from 90°, and the remainder is your latitude.



For example, you wish to ascertain the latitude of San Francisco, and make your observation on October 23.

1. Ascertain your north-south line. (The sun's shadow will cross it on that date at 11 h. 54 m. 33 s. A. M., Pacific time.)

2. The sun's altitude, when the shadow is north, would be found to be 41°.

3. The declination is 11° S. Adding, we get 52°, the altitude of the celestial equator.

4. Subtract: 90° — 52° equals 38°, the latitude of the place of the observer.

The "analemma" employed is a carefully worked-out diagram, giving the position of the apparent sun and its declination for every day in the year. It must be remembered that, each year, this will vary slightly, but for all ordinary calculations, the diagram here given will answer every purpose.

The vertical lines represent the number of minutes the apparent sun is slow or fast—as compared with the mean sun. Since the analemma shows how fast or slow the sun is each day, it is obvious that, knowing one's longitude, one can set his watch by the sun, by reference to this diagram; or, having correct clock time, one can ascertain his longitude.

To ascertain longitude, one must have a true north-south line; also the correct standard time. Now—

1. Note when the sun's shadow is due north. Refer to your analemma and see how far the sun is fast or slow.

2. If fast, add the amount to the time by your watch; if slow, subtract. This gives you mean local time.

3. Divide the number of minutes and seconds past or before 12 by 4. This will give you the number of degrees and minutes you are from the standard time meridian. If the right time is before 12, you are east of it; if after, you are west of it.

4. Subtract (or add) the number of degrees you are east (or west) of the standard time meridian, and this gives you your longitude.

To set your watch you must have a correct north-south line and know your longitude.

1. Find the difference between your longitude and that of the standard time meridian by which you wish to set your watch—Eastern time, Central time, etc. —as the case may be.

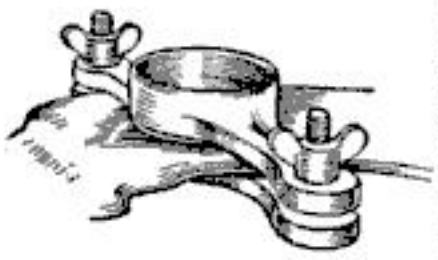
2. Multiply the number of degrees and seconds of the difference by 4. This gives you the number of minutes and seconds your watch is faster or slower than local time. If you are east of the standard meridian, your watch must be set slower than local time; if west, faster.

3. Observe the position of the sun—whether fast or slow—according to your analemma. If fast, subtract that time from the time obtained in step two; if slow, add. This gives you the time before or after 12 when the shadow will be north; before 12 if you are east of the standard time meridian; after 12 if you are west.

4. Set your watch at the time indicated by step 3, when the sun's shadow crosses the north-south line.

To strike a north-south line you must know your longitude and have correct time. Steps, 1, 2 and 3 are just the same as before (in the last example). At the moment of making step 3, you know the shadow is north; then draw the line of the shadow. If out of doors, stakes will indicate this line.

A Vulcanizer for Tire Repairs



SEVERAL new types of vulcanizing devices have recently been placed on the market for the motorist who desires to make his own quick tire repair on the road. They all naturally strive to utilize some material or part of the car. Among those of more than passing interest is one which can be used without special instructions. It is nothing more than a clamp, in which the inner tube is held. On the upper half of this clamp is a hollow, to be filled with gasoline. A one-ounce measure goes with the device, and the ounce of gasoline will burn about seven minutes, which is just enough to effect a complete repair of a puncture.

Another device consists of a plain metal plate which is held by any sort of clamp to the exhaust pipe of the muffler. Putting the inner tube on this metal plate and holding it down on it for about five minutes is sufficient for vulcanizing.

Improving the Old

DURING this winter, when society's revival of ice skating has caused many dance hall managers to turn their polished hardwood floors into ice rinks, manufacturers have studied the patent office files in search of novelties in skates which might be offered to the public.

It is a surprising fact, that a large proportion of patents which have been awarded to inventors have described skates which are capable of being transformed from ice to roller skates at a moment's notice. Many and weird are the skates described in the patents, and hardy indeed would be the skater who would offer to experiment with them on hard and unyielding ice.

A skate which may be used as a ski is shown in Fig. 1. It may be used singly or in pairs, and is designed to be used on a thick crust of snow. The runner projects over the front of the skate, and forms an adjustable handle by which the skees may be steered. A turn of the handles guides the runners in any desired direction.

In Fig. 2 is shown a skate which is claimed by the inventor to have most unusual advantages. The lever which extends upwards from the skate contains a mechanism for clamping it tightly to the shoe. By turning the top, the position of the clamps is changed, and when the lever is swung to an upright position, as illustrated, the clamps are drawn tightly to the shoe. A gaiter is furnished with the skate, and when the lever has served its other purposes, it is fastened to the gaiter, and forms an ankle brace.

When one thinks of the blade of a skate, it is natural to believe that it must be absolutely straight. Should we see a blade that had several kinks in it, we would be tempted to take it to a blacksmith and have him hammer it until it became straight. To do this, however, would be to defeat the purpose of a German inventor, who has patented in this country a skate which has several curves in the blade. Each of these curves is designed to correspond with the natural movements of the skate in use, or with the curve or figure which is described

Fashioned Ice-Skate

by that part of the runner which becomes active. The inventor believes that a steady forward movement is never given during a single stroke of the skate. A glance at Fig. 3 shows this.

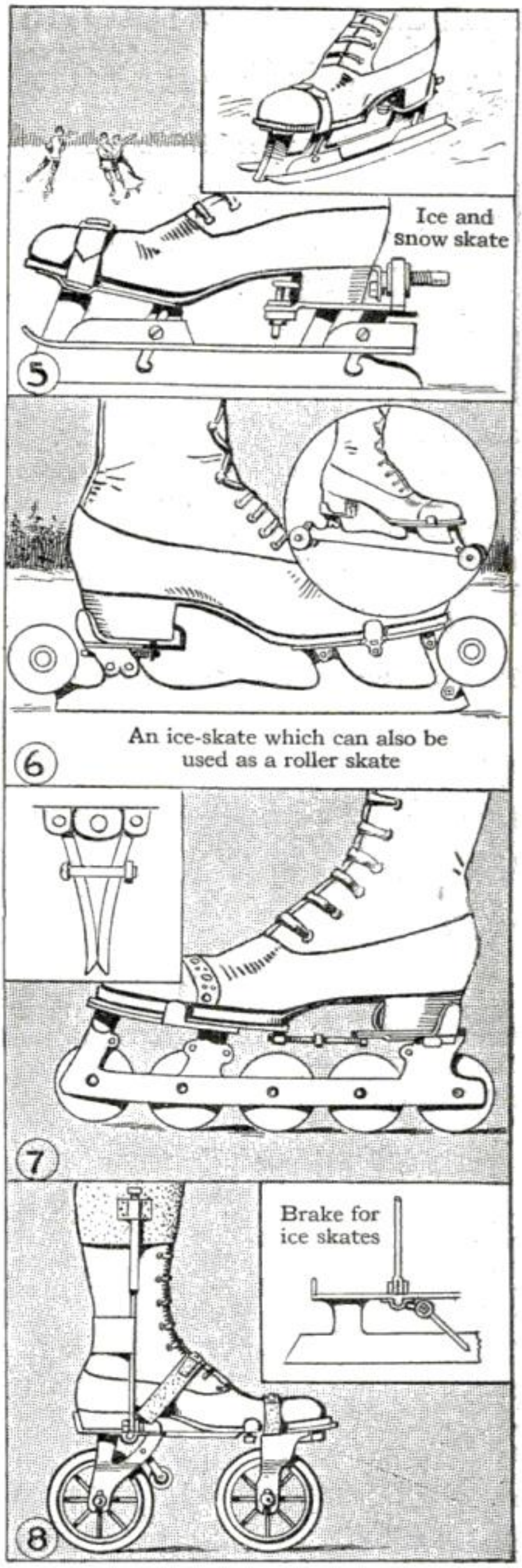
Another German invention is the combined ice and roller skate illustrated in Fig. 4. The inventor has attempted to reduce the friction common to roller skates by employing balls or spheres, instead of wheels. These are attached to the skate by means of bolts, which may be removed to adjust the ice blade.

A skate which may be used with equal facility on ice or snow is shown in Fig. 5. Runners are secured to each side of the blade by means of a bolt, which permits of the runners being lowered flush with the blade when it is desired to travel over snow through which the single blade would sink. This skate has the advantage of being equipped with clamps which will permit the skate being secured to any type shoe.

An ingenious invention patented several years ago is an ice skate which has two rollers mounted on each side of the blade. These are so affixed that when it is desired to skate upon the ice, the rollers are fastened out of the way of the blade, and are ready at any moment to be swung down so that they will lift the ice blade from the ground (Fig. 6).

Another combination ice and roller skate is illustrated in Fig. 7. This skate is unusual in having five rollers attached to the blades when the skate is to be used away from the ice. The ice blade is made in two parts, and the rollers are held between the sections by means of a bolt, which is also used to draw the blades tightly together when the skate is to be used on the ice. Both sections of the blade are slightly beveled, and when drawn together, form a "hollow ground" blade, which is said to be very desirable.

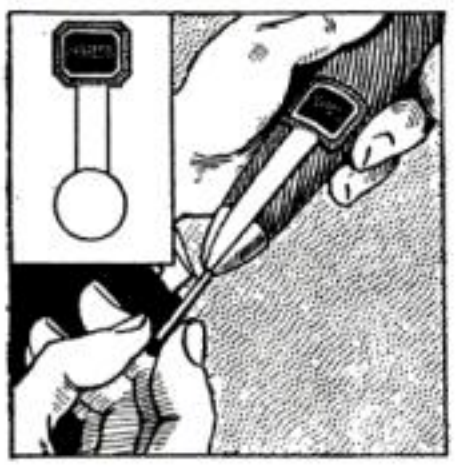
Roller or ice skates which may be equipped with brakes is the subject of the patent shown in Fig. 8. Braces are projected from each side of the skate and fastened to a leather band which is adjusted to fit the limbs. By means of a ratchet, the brakes are operated by swinging the braces forward or back.



Little Inventions to Make Life Easy

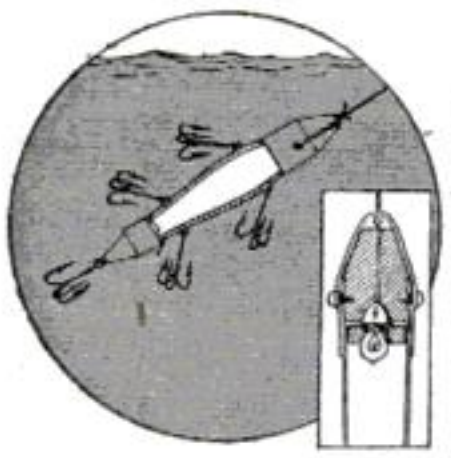
Why Weren't They Thought of Before?

Cigar Tip Protector of Many Uses



A CONE-SHAPED cap to protect the tip of a cigar is made with a projecting piece extending half the length of the cigar. This projecting piece is a label, as well as a surface upon which a match can be struck. In the center of the conical top is a small hole through which a match can be inserted into the cigar, to make a draft opening without cutting the end of the cigar.

Tricking Fish with Electric Minnows



AN artificial minnow for angling is provided with a transparent body, within which is placed a small electric light. The invention is to illuminate the minnow in order to attract the attention of the fish. Of course, a number of hooks are attached to the sides of the device to catch the too inquisitive fish.

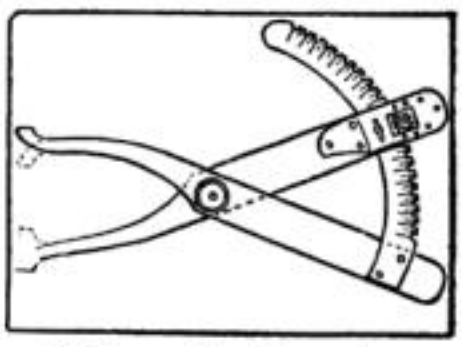
Head-Guard for Alley-Boys

A SPHERICAL wire cage, made in hinged sections, is provided for the protection of alley-boys against flying bowling balls and pins. The cage completely surrounds the boy's head and face, and pads are provided to hold it in place. A hinged section is also provided for each shoulder.

Trapping Mice in a Milk Bottle

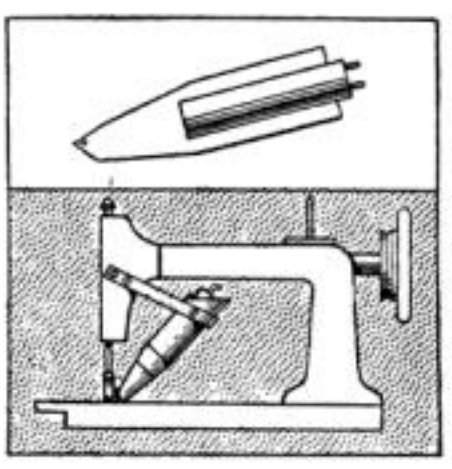
THE trap is composed of top and bottom sections which are placed in an old milk bottle. The mouse enters at the mouth of the bottle and finds himself in the upper section of the trap. Surrounding this section is a trough filled with liquid bait. When the mouse attempts to climb out, his wet feet slip on the glass walls of the bottle and he falls through the central hole in the trough down into the lower section of the trap. The two sections of the trap may be separated in order to remove the entrapped animal.

More Accurate Calipers



ATTACHED to one leg of a pair of calipers is a rack upon which teeth are cut to fit a worm gear which is affixed to the other leg. The width of the jaws of the calipers is regulated by means of the worm gear, and it is claimed that great accuracy may be obtained.

Burnishing With the Sewing-Machine

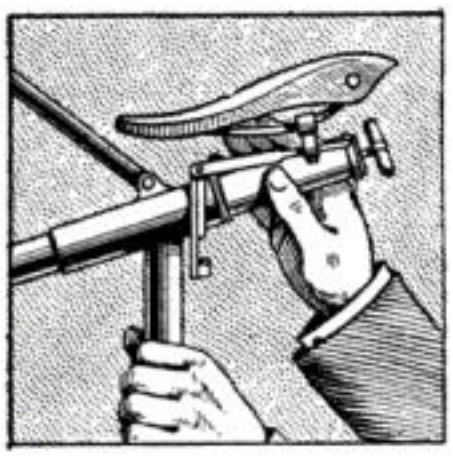


THE burnishing tool is made of a tapered, cylindrical tube of metal, in which is inserted an electrical device for heating the tool. At the lower extremity is a slot through which the margin of the material to be burnished may be placed. The device may be easily attached to a sewing-machine.

A New Kind of Pin-Cushion

THIS pin-cushion represents a Chinese face, the lower portion of the pigtail being composed of threads which can be withdrawn. Through the center of the cushion a box penetrates, which may be used to hold buttons, thimbles and other useful implements. The bottom of the box is designed to hold needles, thus acting as a needle case. The entire device hangs from the wall by the pigtail.

Bicycle Frame Holds a Tire Pump

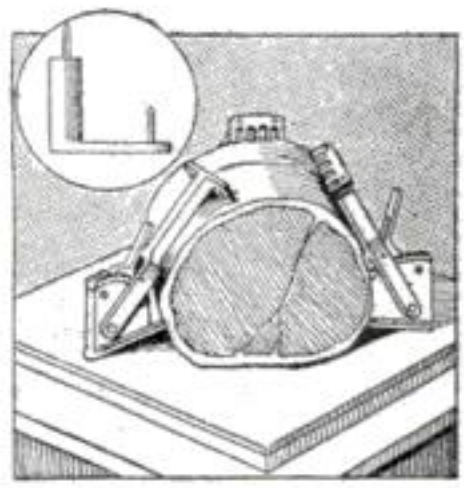


THE steel frame of a bicycle or a motor-cycle is made hollow immediately beneath the rider's seat. Into this hollow space is slipped a tubular tire pump. When the pump is needed, the seat is swung out of the way on a swivel, the cap which closes the open end of the frame is unscrewed, and the pump may be removed.

Collapsible Millinery for Traveling

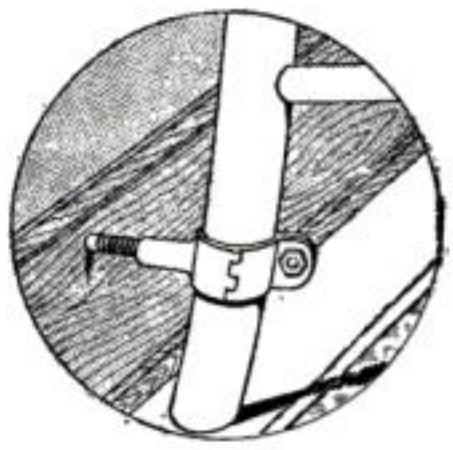
TO provide a fashionable hat which may be folded up and placed in a travelers' trunk or suitcase, a dressmaker has created a design which is composed of two stiffened sides and a soft collapsible middle on the principle of the paper hats made for carnival time. When the hat is placed on the head, the stiff sides are bent to open the hat in its proper position. When it is taken off, the hat flattens so that it can be stored away in a small space.

Holding Meat While Carving



UPON a suitable base is fixed a casting consisting of three equidistant arms, each terminating in a toothed quadrant. Actuating on these quadrants are arms to which are affixed claws for holding the meat. In the center of the device is a small plate, to which are attached two metal points of different lengths, designed to pierce the meat and to hold it in the center of the device. This plate may be clamped in any desired position by means of a bolt which is equipped with a thumb-nut. Either large or small pieces of meat may thus be accommodated.

Preventing Furniture from Chipping Walls

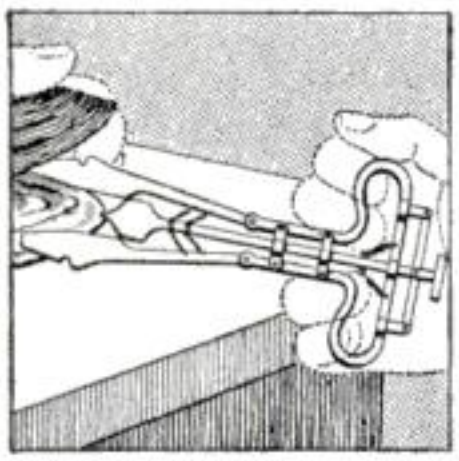


FITTED into the threaded interior of a boss which is attached to the resilient clamping-ring of the furniture buffer, is a wooden or metal screw, equipped with a rubber button at the end. When the clamp is applied to the leg of a chair or bedstead, the rubber tip on the adjustable screw acts as a buffer to prevent the marring of the wall.

A Cutter for Fiber Phonograph Needles

A DEVICE for trimming or cutting fiber phonograph-needles is modeled closely after a pair of ordinary scissors. The top element of the device is equipped with a holder for the needle, while the lower element has a sharp blade for trimming the needle.

Conquering the Obstinate Oyster



A PAIR of jaws are hinged to a T-shaped handle. Between the jaws is placed a sliding cam, terminating in a button protruding from the handle of the device. By pushing the button, the cam is pushed down between the jaws, thus spreading them, and opening the oyster.

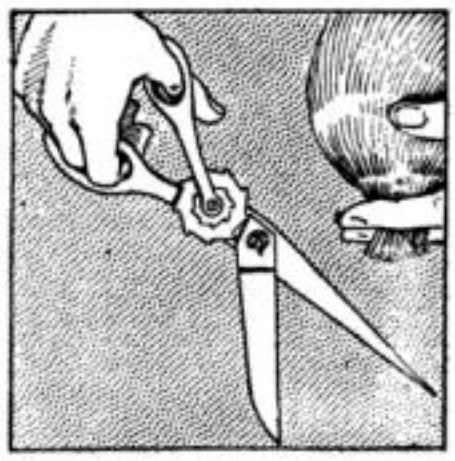
Can Maidenly Modesty Ask for More?

A SHELF is provided for the seats of the patrons, the seats being placed considerably above the workmen's floor. In front of the seats is placed a desk, the lower part of which forms a curtain, leaving just enough space above the floor to allow the workman to reach the shoes of the patron. A speaking tube is placed before the patron on the desk so that she may give instructions to the workman, and by means of an electric light signal, the completion of the process is announced.

A Muscle-Saving Potato Masher

A SPINDLE, running vertically through the center of a hopper, is rotated by a suitably geared handle. A set of rotating arms at the bottom are actuated by the spindle to force the mashed vegetables through a perforated plate or sieve. The chief improvement consists in the rotating arms, which are toothed on the upper edge, thus serving to grate the potatoes before they are forced through the sieve, obviating any possibility of the potatoes' remaining lumpy or hard.

One Motion of the Handles Works These Scissors' Blades Twice

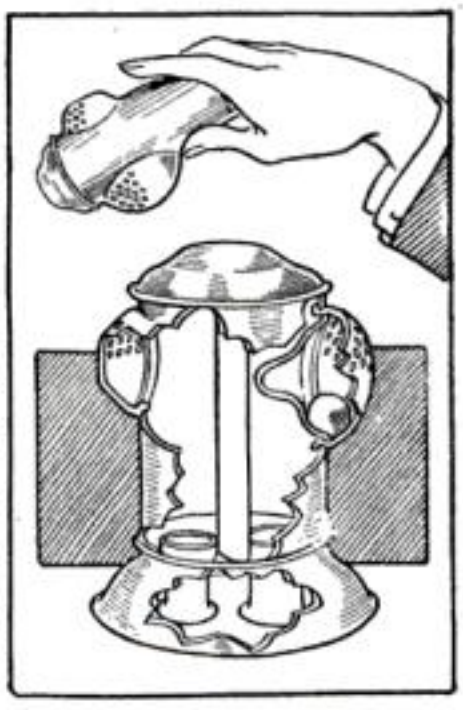


THE shorter blade of the scissors is actuated by means of a ratchet, which, as the handles are spread apart, opens the scissors. A spring closes the blades when the plunger has passed the tooth of the ratchet. The device may be made to close the blades twice for every movement of the handles by spreading the handles wide. By so doing two teeth actuate the plunger.

A Paper Milk-Bottle with a Window

A RECTANGULAR opening is cut in the side of a bottle made of paper, pulp, or other opaque material. Into this opening is inserted a section of transparent material, such as celluloid. A flange on the inside of the bottle prevents the window from being pushed out by interior pressure, and when the process is finished, the joints are covered with transparent cement.

A Salt and Pepper Shaker



A RECEPTACLE is divided equally in two parts, to serve as a combined salt and pepper shaker. A screen is fitted on opposite sides of the device, so that either seasoning may be poured out singly. A ball is held near the screen in the salt compartment to break the lumps of salt to a fine consistency.

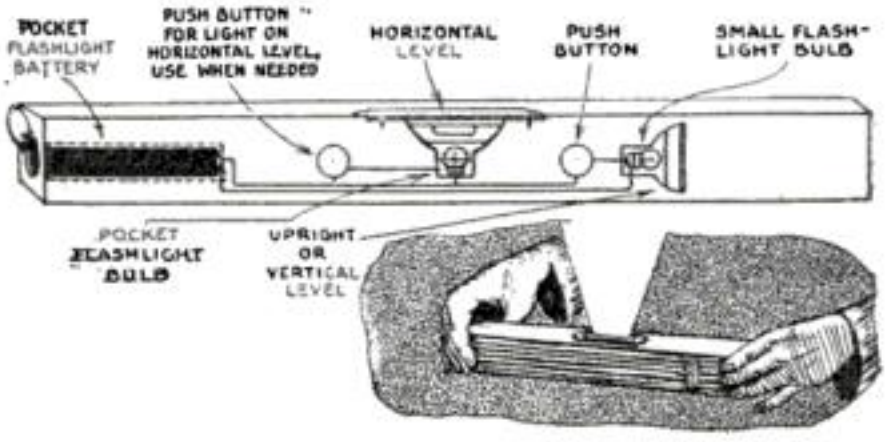
For Practical Workers

A Spirit-Level for Use in Dark Places

A MILLWRIGHT must often set up machinery and benches before a tenant has moved into a building. As the gas and electric lights are not turned on before the tenant takes possession, it is hard to level shafting, foundations, benches, etc., in dark places, especially on dark, rainy days. Candles are often employed, but both hands are required. With the level to be described, one hand is always free.

Use a small, round flashlight battery and drill a hole in one end of the level, large enough to hold it. With a ruler as a guide, make grooves with a thick-set penknife on the outside of the level to hold a fine wire. Push the wire in with a screwdriver, fill in the top with rosin or wax and finish smooth. Drill holes under each level, just deep enough to hold a flashlight bulb. Solder wires on them, and fill in with rosin or wax and finish smooth. The rosin or wax filling will hold the wires and bulb securely.

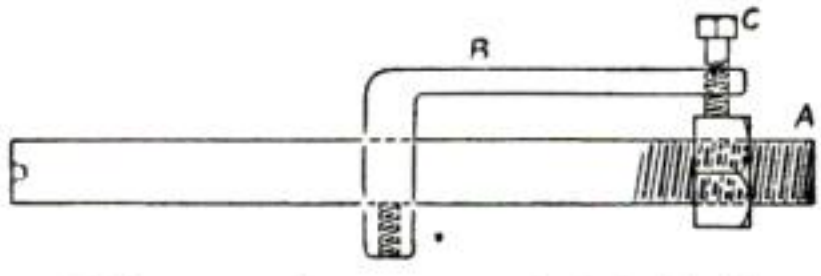
Drill holes for the smallest size buttons obtainable, and push the buttons in with a block of wood. A three-wire system is employed. The buttons are so located that the hand which places the level, lights the level with the thumb of that hand, thus leaving the other hand free to work with. A sliding cover is put on the end and screwed in to keep the battery in position.—T. F. BUSCH.



A spirit level equipped with a small flashlight will be found very useful for use in dark buildings

To Face Left-Hand Nuts

IN facing left-hand nuts, damage is often done to the facing tool or nut arbor, by the nut's starting to unscrew, and pushing the tool to one side or breaking it. The nut arbor or mandrel shown, will prevent the nut from coming loose, holding the nut in place until one side has been faced. It consists of the threaded piece *A* on which the arm *B* is held by the set screw. When the nut has been screwed up tight, the shaft arm *B* is set so that the cap screw *C* can be tightened up against one of the flat sides of the nut. The set screw should have a copper end if it is used on nuts that have had their sides finished. When many nuts are to be faced, it will pay to make a small cam that pivots on the end of the arm *B* to take the place of the screw *C*. The arbor can be held between lathe-centers or made to fit the mandrel of any lathe.—C. ANDERSON.

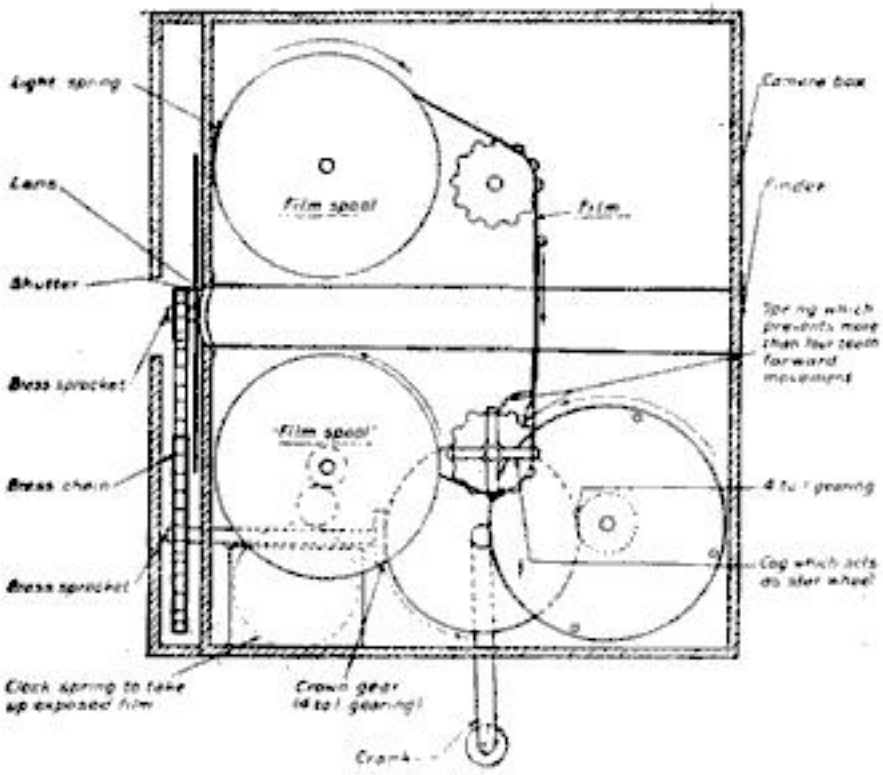


This nut arbor or mandrel holds the nut in place until one side has been faced

Home-Made Motion Picture Camera

THE motion picture camera shown in the drawing is very simple in construction and operation. It holds standard film rolls and is about 5″ by 7″ by 8″ in dimensions.

The film passes from the upper magazine over the toothed spool, down



The working mechanism of a home-made motion picture camera

through the slot where the exposure is made (size of exposure ¾″ high by 1″ wide) and then over the lower toothed spool on to the take-up reel, which is keyed to the shaft on which it rests. The shaft in turn is connected through gears to a clock-spring. This gives the reel the power to take up the exposed film as used.

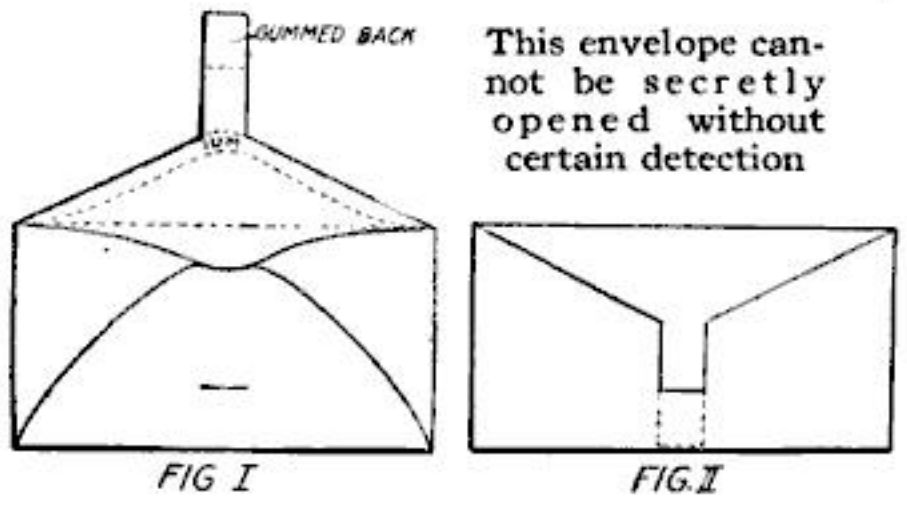
It will be noticed that the lower toothed spool has a four-toothed gear fastened to its shaft. The action of the large wheel, which contains the four pegs, on the four-toothed gear is similar to the Geneva movement on most motion picture projectors. This large wheel is driven from the crank by four to one gearing, and as each of the pegs turns over four teeth of the little spool, the height of one exposure or ¾″, sixteen exposures are made to one revolution of the crank. Two little springs rub on the toothed spool to prevent slipping of the film in either direction, which action should take approximately one second.

A universal-focus lens is shown in the drawing, but a focusing lens may be used, in which case the shutter must be placed behind. The shutter is of the semicircular revolving type, driven through the chain and gears from the crank at a ratio of sixteen to one, or sixteen revolutions of the shutter to one of the crank. This will make a revolution of the shutter to each exposure. By shifting the chain forward or backward, the shutter can be made to uncover at the proper moment; that is, just after the fresh section of film has come to rest.

Before using the camera the spring must be wound. A cover should be kept over the lens.—E. G. GETTINS.

The Flap-Lock Envelope

THE ordinary envelope when sealed can very easily be opened and resealed, and the chances of detection are rather slight, especially if care be taken when resealing to see that the flap is put back in the exact position it first occupied. The attached drawings illustrate a distinct improvement on the old style flap. Instead of rounding off into a point, it is extended into a narrow strip, the length of this strip being the exact difference between the rounded point of the old-fashioned flap, when sealed, and the bottom of the envelope. A slit is cut in the back of the envelope, a little wider (1/16″) than the width of this strip, half way between where the rounded point would come and the bottom of the envelope. The flap is gummed in the



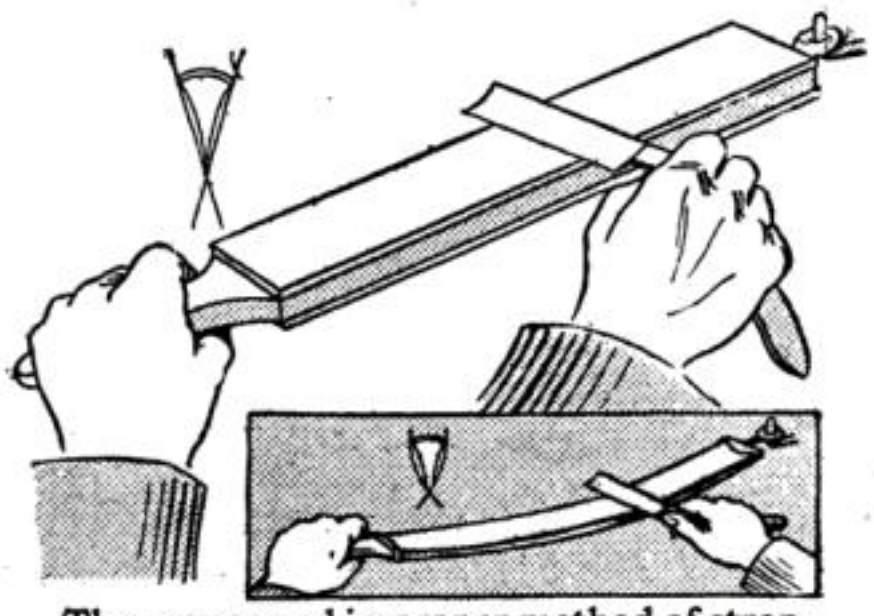
This envelope cannot be secretly opened without certain detection

ordinary way, and the extra strip is gummed on the lower half of the opposite side, Figure 1.

The envelope is sealed as usual. The gum on the lower outside half of the strip is dampened, and the strip is easily slid into the slit in the envelope and pressed down, sealing it to the inside of the envelope, Figure 2. Opening and resealing this envelope, undetected, is practically impossible.—J. A. MCMANUS.

How to Make a Self-Honing Razor Strop

MANY men do not know how to hone a razor. Twice a year they give their good razor to a barber or a tool grinder to hone, and it is often returned with the temper so far gone that it will not hold an edge. The red side



The proper and improper method of stroping a razor, showing why a flexible strop ruins the blade

of every strop, which is used for sharpening, is a strip of leather soaked in a mixture of crocus and kerosene. The black side (finishing side) is soaped, black, tanned leather. To retain a sharp, straight edge on a razor for life without honing, a straight flat strop must be used. You cannot hold a flexible strop tight and straight enough to prevent the formation of a blunt or rounded edge on a razor. That is why a razor must be honed every six months; it will not shave if the edge is too thick. The thin, concave edge that cuts can be retained only by using a flat and straight, non-bending strop, like the one illustrated.

Get a piece of hard wood 14 in. long, 1½ in. wide and ¼ in. thick. Plane and sandpaper it to a smooth surface. Cut a handle at one end. Get two strips of smooth-finished horsehide (or cowhide, if you cannot get the other) 10 in. long, 1½ in. wide and about ⅛ in. thick. Coil one strip of leather to fit into a tomato can. This will save space and material. Get 25 cents worth of crocus (accept nothing but dry, bar crocus) from a machine shop supply store or a polishing concern. Mix this with enough kerosene to make a thin paste. Pour this on the strop until it is covered above the strop level and allow it to soak seven days. Clean off with cloth, and cement both leather strips on the wooden strip, using a good tire or leather cement, and allow it to dry, using several flat-irons as weights.

Crocus is the finest emery there is. It is used for polishing nickel and brass and does not scratch. The finishing side of the strop should be lathered with soap and rubbed in until dry.

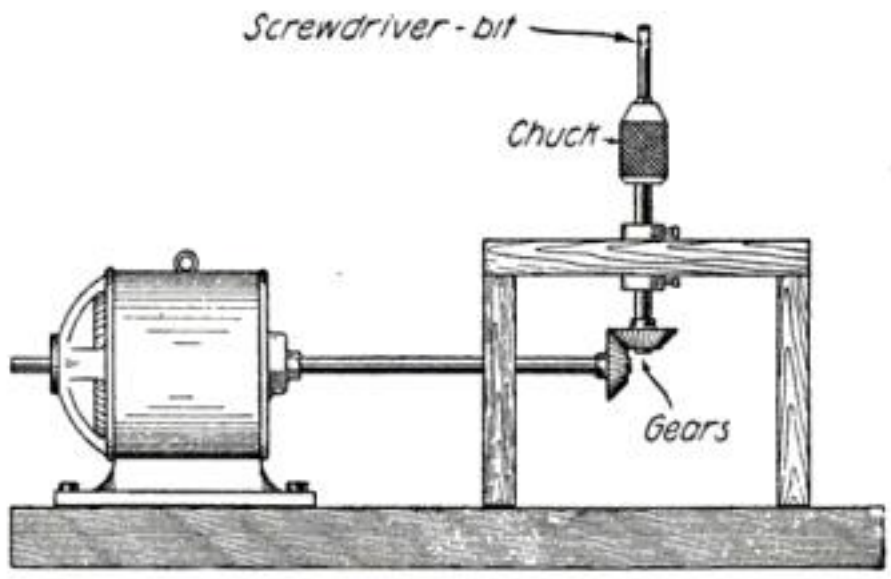
Do not throw the crocus mixture away. Bottle it, and use it for polishing purposes. Also apply it to your strop once a year to keep it effective.

Strop your razor flat. The lower diagram shows how a flexible strop wears down the edge of your razor to a rounded edge.—F. T. BUSCH.

An Electrically-Operated Screwdriver

A HANDY and practical screwdriver, operated by electricity, will more than pay for itself in a very short time.

An electric motor is fastened at the left side of a base of wood. A small wooden structure, as depicted, is built of posts, and a small hole is drilled at the top cross post to admit and allow the



This electrically driven screwdriver may be conveniently held in the hands

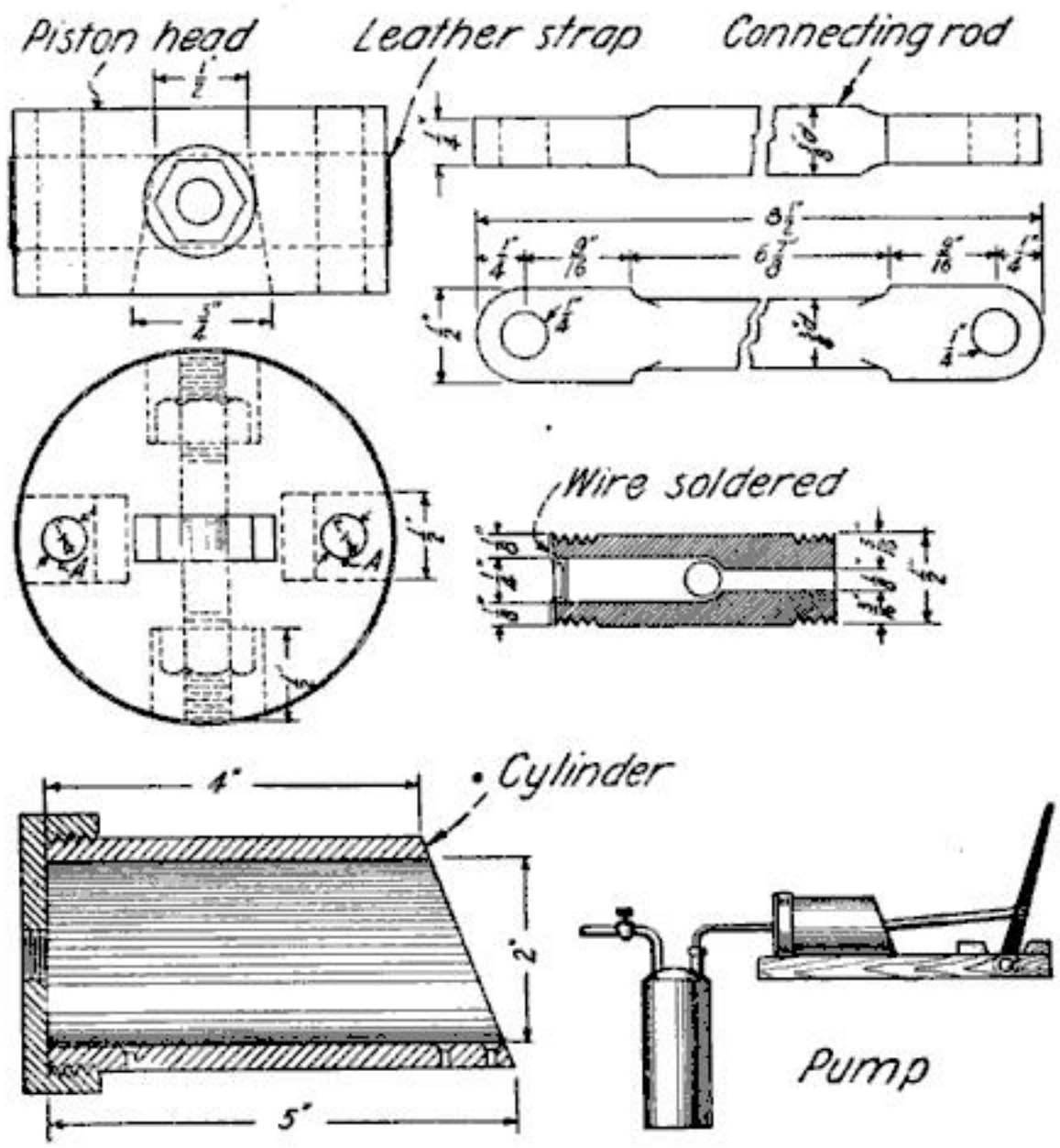
free movement of the steel shaft with the chuck. An arrangement by which the motor rotates the steel shaft (with chuck) is clearly shown. This device consists of two threaded pieces one on the end of the steel shaft of the motor, and the other on the end of the shaft with chuck. A chuck is threaded on to the upright shaft, and with a set of bits, drills, and so forth, including taps, very good and quick work can be done with this apparatus. The base being rested against the body and the current switched on, the apparatus does the rest.

A Simple Air-Pump

IN order to obtain great heat or a high temperature, with a blow torch, it is necessary to have a tank supplying compressed air.

Obtain an iron-pipe, 2″ inside diameter, and having one end closed up with a pipe-end which may be removed at will by unscrewing. In the center of this end drill a ½″ hole and thread with a standard thread. The pipe should be cut 5″ long. Now from the plain end measure in 1″ and cut the pipe diagonally across, as shown in diagram, ⅛″ holes should then be drilled at either end and in the same line of the pipe. These holes are for the screws, which are to hold the cylinder in place on the base, and therefore they should be sunk rather deep so as not to interfere with the working of the piston. It will be a good idea to smooth the inner sides of the pipe with some emery cloth.

The piston is the most important part of the pump and ought to receive most attention. It is made of a wood disk 2″ diameter and 1″ thick. In the middle on the disk a hole is chiseled out measuring ½″ x ¼″ at the bottom and ¾″ x ¼″ at the top and is ⅜″ deep. Through the middle of the side and passing through the center of the circle of the disk, a ¼″ hole is drilled right through from one side to the other. At either end of the hole and with the same center a ½″ hole is now drilled. This is to admit the piston pin and the ½″ holes admit the nuts at either end. This part may be seen in the diagram. *A* and *A1* are the inlet valves and are ¼″ diameter, and the center of each hole is ¼″ from the edge of the disk. Leather is placed in these holes measuring ½″ x ⅝″ and is glued to the disk by a section about 3/16″ from the farthest edge of the leather hinge. The drawing shows this by dotted line across the rectangle. In order that there will be little or no leakage, a ½″ leather strap is wound around the disk ¼″ from top and bottom. This is done by making a ridge 1/16″ deep and ½″ wide in the middle of the side of disk when it is turned out. The leather should be glued in with the rough side out.



Construction diagram of a simple air-pump which will supply a blow torch with compressed air

The connecting rod is made of ⅜″ iron rod. The length when finished should measure 8½″. This length is not at first needed because we flatten the ends out to the shape and dimensions given in drawing. The holes are for the bearings of piston and arm pins. It is very easy to forge the ends in a fire made for heating the house and to hammer them on a small piece of iron.

The air is kept from returning to the pump by a valve set on top of the tank. The drawing gives all the information necessary. The ball bearing used is a little smaller than ¼″ (perhaps 3/16″). The wire at the top prevents the ball bearing from escaping.

The pressure arm is 1″ x ½″ x 10″ over all. Holes are drilled ⅜″ and 3″ from one end. One serves as the pivot

pin and the other as the connecting rod pin. The end should be rounded off to give the arm play in the bottom of the base. Stop pieces prevent the arm from being pushed or drawn too far. A slot 1″ x ¼″ x 1″, which is through the arm, allows the arm to move freely on the connecting rod pin. The pin is nothing but a ¼″ bolt, 1½″ long.

The receving tank used is made from an old hot water boiler usually found in homes where the hot water is not supplied by the house.

If a pump is made in this way it will surely give great satisfaction.

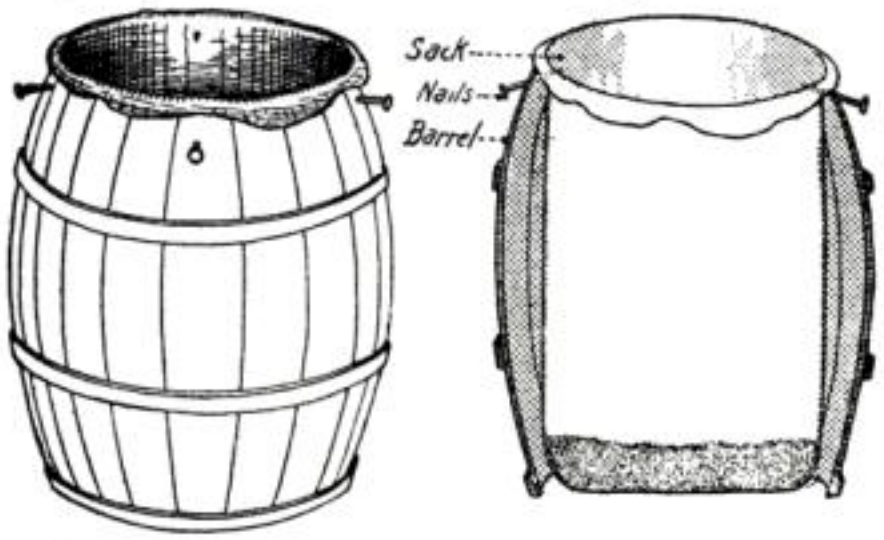
Gage for Duplicate Hole Drilling

DRILL the hole to the required depth and measure the distance exposed on the auger bit. This distance is taken from the face of the work to the end of the jaw protruding from the chuck of the brace.

Secure a block, say 1¾″ or 2″ square, which is as long as the distance previously measured. Drill through this block and allow it to fit over the auger bit, acting as a sleeve. The only exposed part of the auger bit will then be equal to the depth of the required hole.

A Barrel for Filling Sacks

THE clumsy performance of holding a sack and filling it at the same time can be simplified if the sack is hung in a barrel. Four curved nails are placed at equal distances in the rim, and the sack is suspended from these. When it is filled, the sack can be easily removed.

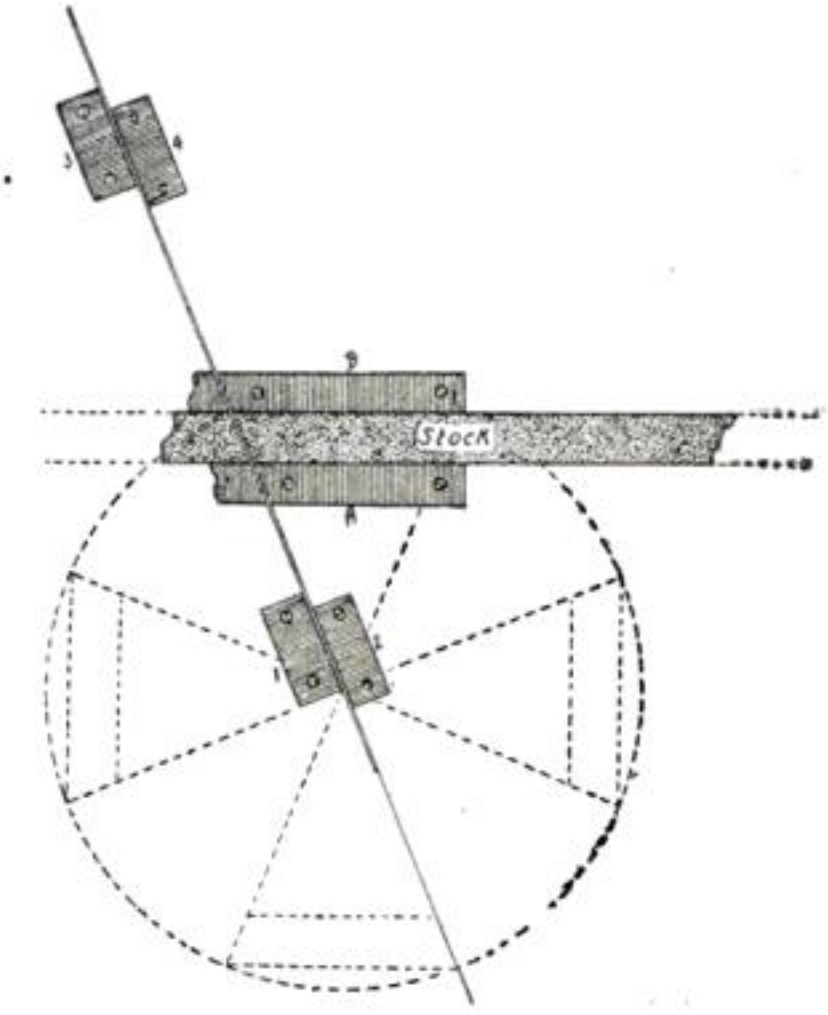


A few curved nails in the rim solve the problem of keeping a sack open while it is being filled

By the use of this device, one man can do the work of two and in less time, with practically no outlay.

How to Saw Difficult Angles on Small Stock

IN making a craftsman lamp, a very rigid miter is needed to cut unusual angles on small stock. If no miter box is at hand, the following device may be substituted. Use a smooth board about 1 in. thick and 18 in. sq. as a drawing-board and lay out the work directly on this board. Nail on cleats as indicated and the miter is ready for use. It is possible to secure very great accuracy and rigidity with very little trouble. In the case of one lamp, 44 pieces ½ in. by

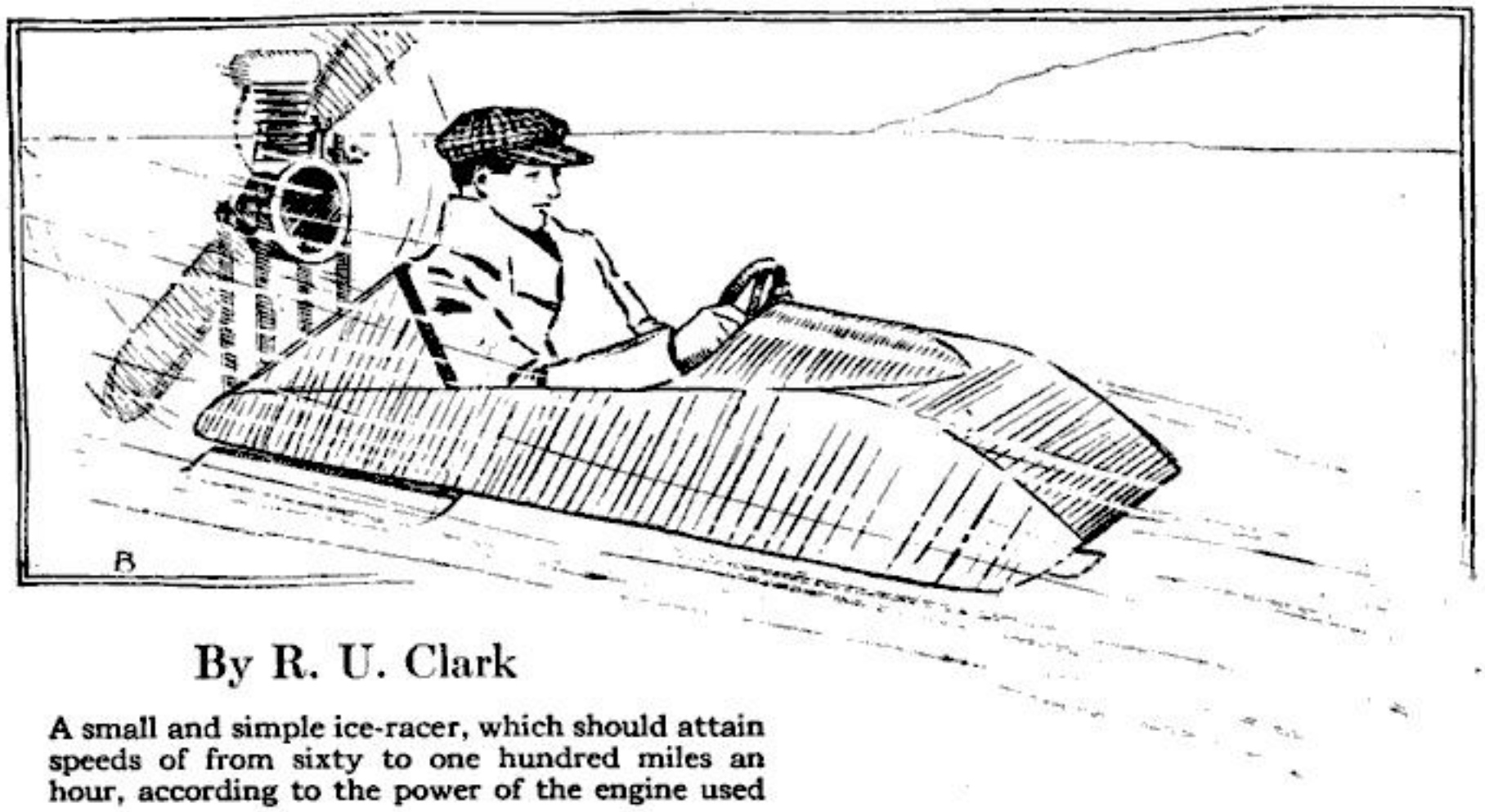


The cleats and the drawing take the place of a very rigid miter-box

½ in. by 3 in. were cut with bevels to form an eight-sided box, built up of these pieces as a child builds up dominoes. The pieces were so accurately cut that they went together perfectly.

The drawing is first made very accurately, then blocks No. 1, 2, 3, 4, are nailed on the board along the diagonal. Enough room for the saw kerf was left holding the saw in position against Nos. 2 and 4 before nailing on Nos. 1 and 3. *A* and *B* are now nailed on, allowing just enough room for the stock. The first cut trims the first end on the stock, at the same time removing the surplus ends of *A* and *B*. Care must be taken that blocks 1, 2, 3, 4 are right-angled on the sides.—E. A. HODGSON.

How to Build an Aero Ice-Racer



By R. U. Clark

A small and simple ice-racer, which should attain speeds of from sixty to one hundred miles an hour, according to the power of the engine used

ILLUSTRATED accounts of several motor-driven ice-boats have appeared for some time past in different publications. The machines depicted have been more or less alike, and practically all have born a close resemblance to an ordinary sled fitted with a motor. In many cases these vehicles have been greatly overpowered, for although some of them have attained to speeds as high as eighty miles an hour, they have accomplished this with considerable waste of power, principally because of their faulty design, both as regards body shape and propelling mechanism.

In designing any high speed vehicle the body and all the external parts should approximate a pure streamline form as nearly as possible. This fact has been thoroughly demonstrated during the past few years in the case of the aeroplane, and during the past season has been forcibly illustrated at the auto races. In the case of the motor-driven ice-boat, the necessity of a streamline body is far more apparent when it is considered that more than 95% of the tractile power is consumed in overcoming the resistance of the wind where traction is secured by direct aerial drive.

In addition to being essential to high speed, a closed-in ice-boat body affords a very necessary protection from the cold and wind, which alone would be reason enough for constructing such a vehicle along these lines. It therefore seems strange that, in spite of these facts, people should think a wooden cross equipped with runners and a motor, a fit apology for a motor ice-boat, but this is probably due to the fact that the advantages of closed-in construction are not fully realized, and consequently the builder does not care to take the time to build a decent body.

A motor ice-boat to be worth while should combine the following features: Strength, lightness, cheapness, proper streamline form, complete protection from the wind, and above all ease of construction. Fortunately it is a very simple matter to design and build such a body, as will be at once apparent after a glance at the illustrations submitted herewith. As will be noticed from these sketches there are two possible seating arrangements which allow of simple streamline body construction. The machine depicted in Fig. 1, with the motor at the rear, is designed primarily for use as a single passenger machine, in which case the body need not be over five feet long, by about twenty inches

wide. By enlarging the body as regards length and width, from three to four passengers could be carried, provided the body was strengthened accordingly, the occupants sitting in the same manner as they would on a double runner sled. This requires a few inches additional width to the body.

Fig. 2 shows a different motor and seating arrangement from that submitted in Fig. 1. On the machine in

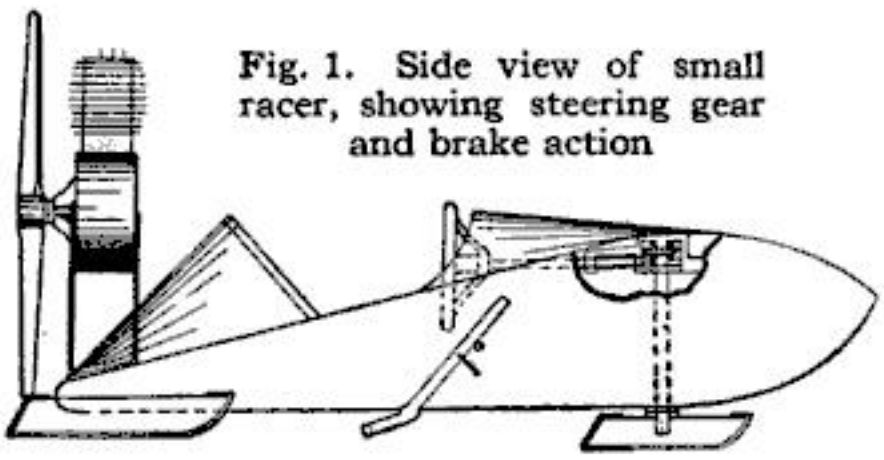


Fig. 1. Side view of small racer, showing steering gear and brake action

Fig. 2 the motor is placed in front, driving the propeller, through a long shaft, at the rear. This shaft runs between the passengers along the middle of the vehicle, as can be seen from the top view plan in Fig. 2. Note that the shaft is enclosed where it passes through the cockpit. From this sketch it is apparent that sociable seating is employed. This requires a wider body which tends also to cut down the speed, but at the same time allows of several passengers being carried, and the use of more power.

The body construction is practically the same in either machine illustrated in this article, but, of course, due allowance should always be made for the weight carried. A one or two passanger machine may be constructed so as to weigh little over 100 pounds complete, but in all cases it is advisable to build a light frame to lay the planks on, although in the case of a small machine it is perfectly possible to obtain sufficient strength from a body constructed of four boards of the proper shape fastened edge to edge, in which case the side boards should be fairly thick, or else have their edges re-enforced with moulding inside.

As has already been stated when tandem seating is utilized the motor should be situated at the rear, in which case the aerial propeller can be directly connected to the crank shaft of the motor, thus constituting the complete power transmission.

The runners for both of the models described in this article are constructed in the usual manner of wood, shod with steel or iron edges, these being formed of square rods set in the wood edgewise so as to present a sharp running edge to the ice. They are held in this position by their extremities, which are flattened and secured to the wooden runners.

Both machines can be made with only three runners, one in front by which the boat is steered, and two at the rear. The size of these runners depends to some extent upon the load to be carried, but for ordinary use runners from twelve to eighteen inches long should prove entirely satisfactory. When it is the intention of the builder to carry many passengers, the spread of the rear runners should be widened considerably, or else the machine should be fitted with four runners.

The steering of the motor ice-craft here described is accomplished by means of two beveled gears and shafts as illustrated. This fixture can be rigged up by using the gear mechanism found on an old ice cream freezer. This changes the plane of rotation as desired and

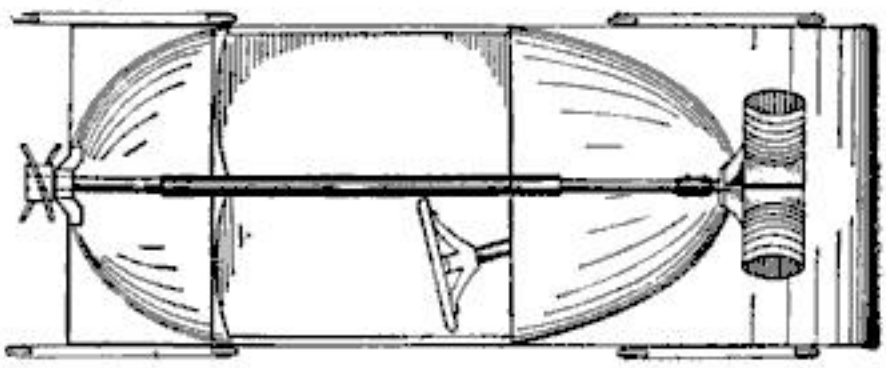
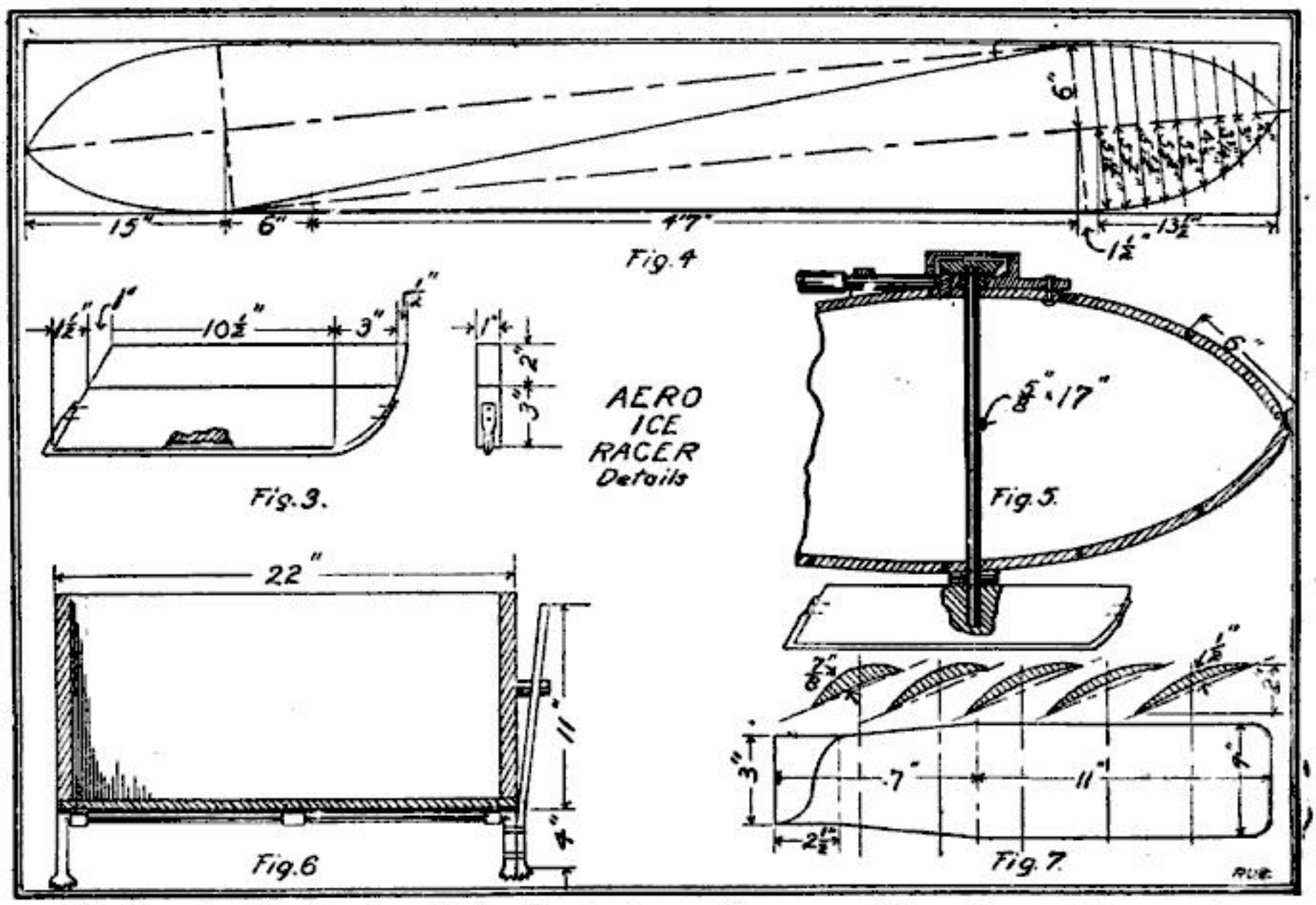


Fig. 2. Top view of another form of racer, in which the motor is in front, and the propellor at the rear. This form of machine holds two passengers

saves the cost of a regular steering mechanism. In case the former device is employed, a large steering wheel should be provided, as the ratio of the gears utilized is rather high.

Braking the speed of the aero ice-boat is accomplished by means of the lever drag brake shown in the drawing. The complete brake is constructed of two pieces of iron or soft steel riveted together and forged to the shape illustrated. The brake is held in the proper position when not in use by means of a



Working drawing showing details of a simple aero ice-racer. This entire machine may be built for less than twenty dollars, if good judgment is used in buying materials

spring and a small wooden block, as can be seen by referring to the drawings. The bottom edge of the brake should present several rough teeth to the ice. This prevents any sudden catching due to lumps or ridges in the ice.

The small shields on the top of the body are intended to cut down the resistance caused by the bodies of the passengers, and can be constructed of metal or fiber. They are semi-conical in shape as shown, and afford considerable protection from the cold.

A motorcycle motor is very well suited for use on a motor ice-racer. These motors can be bought second hand in running condition at most any price from $8.00 up, and ranging in horse power from 3 to 20. The smallest of these weigh only about 40 lbs. complete, and are capable of driving a small ice-racer at considerable speed.

The speeds possible with the aero-driven ice-boat range very high when the craft in question is properly designed and constructed, and if sufficient power is used. Even the smallest craft should be capable of a speed of a mile a minute when well made, and with a powerful motor a good machine should attain a speed of nearly 100 miles an hour; a great deal, however, depends on how well the body is designed and constructed, and how well the motor runs.

Having described the aero ice-racer in a general manner, it is next in order to furnish detailed instructions for the construction of a simple craft of this type which will give the most satisfactory service, and at the same time require the least effort in the making. A machine of this type is therefore described following the design in Fig. 1.

To begin at the bottom and work up. Three wooden runners should be made of clear stock at least 1″ in thickness. One of these is represented by the lower portion of the runner shown in Fig. 3. The other two should be similar in shape to the entire runner illustrated in the same figure. The dimensions for these are given in the drawing. The shape can be laid out from the sketch by marking off the chief dimensions as indicated and drawing in the curves free hand.

A V-shaped groove ⅜″ wide by 3/16″ deep is cut along the middle of the bottom of these three runners with a miter-

box saw, and is continued part way up both ends as shown in Fig. 3.

Three 18″ pieces of ⅜″ square iron or soft steel should be procured and the ends flattened, by hammering two opposite edges, for a distance of about 1½″, and two 3/16″ holes bored in each end so that the iron runners can be attached to the wood, after being bent while cold to the approximate shape, in the exact manner shown in Fig. 3. These iron runners are held in place by 3/16″ brass screws countersunk. The screws should not be less than 1″ long and should have flat heads.

If the wooden runners are over 1″ thick they can be made of soft wood, and it will be possible to run the craft over the snow even if it is only packed to a small degree.

The small runner mentioned above is for the rudder, and is placed in the front of the machine. A ⅝″ round steel rod 17″ long is sunk into the center of this runner to a depth of about 2″, and is held in place by two 3/16″ steel bolts which pass through the rod and runner, as in Figs. 1 and 5. Four or five ⅝″ washers are slipped on the rod.

Fig. 4 shows plainly how to lay out the sides of tl.e boat body. Both sides can be cut from 7½′ board ¾″ thick by 12″ wide. The dimensions are taken from the sketch and are laid out on the boards in the exact manner shown. The proper curve for the bow is obtained by marking off various points at different distances from the center lines, as shown, and connecting these points until a fair curve is obtained. Spruce is one of the best materials, as well as the cheapest, for making the body, but should be free from splits.

Nineteen pieces of ½″ by 6″ stock exactly 22″ long are now required. These should be of selected spruce and are used for the bottom and deck of the boat body. They are laid on crosswise. The side boards should be held the proper distance apart temporally by several short sticks nailed at various points along their edges, and the entire bottom nailed in place with 2″ nails. The bottom board should overlap about ¾″ at the front of the body.

The rear edge consists of a piece of spruce 20½″ long by 1″ thick by 2″ wide. This is nailed in place between the sides before the first rear deck board has been laid on, and properly beveled at the same slant as the sides. The rear deck board is then nailed on, the nails along the back being set in ¾″ from the edge. The rear edges are then rounded off to decrease the wind resistance, and give the body a finished appearance. Two more 6″ boards are then laid on, thus completing the rear deck, which is composed of three boards in all.

The deck board nearest the bow is now laid on in such a manner that its lower edge meets the front bottom board. First, however, it should be beveled to the proper angle to allow of a perfect fit. The top edge of the bottom board is then rounded over to a blunt point. These details are illustrated in Fig. 5. Three more top deck boards are then put into place. The front boards should be steamed before bending.

In the third boards back from the front, on the top and bottom of the body, ⅝″ holes should be bored midway between the side planks, and 2″ in from the rear edge of the boards in question. The hole in the bottom board is re-enforced by a ⅛″ iron plate, 2″ square, drilled in the center to correspond with the hole in the bottom plank. This plate is placed on the outside as shown in Fig. 5.

It is now in order to insert the upright shaft, affixed to the small runner, in the two half-inch holes bored for this purpose. The top of the shaft is then filed square in such a manner that it makes a good fit with the hole in the bevel gear, of the rotating device of an old ice cream freezer, which turns the dasher. This mechanism is seen in place in Fig. 5. It will be noticed that in this figure the housing for the gears is bolted direct to the upper deck on the outside, while in Fig. 1 it is placed under the deck. The former method of outside mounting is by far the simplest, and probably the best. The crank shaft of the freezer mechanism is slipped into an 8″ piece of heavy brass tube, which should fit snugly over it, and should be secured to prevent movement in any direction by two ⅛″ pins passing through the tube and shaft. These pins

should be made of steel, and should be riveted in place. On the end of the brass tube is mounted the steering wheel. A good idea of the complete device can be gained from Fig. 5.

The two rear runners should now be bolted to the body of the craft with ¼″ bolts. These runners should overlap the rear of the body by 3″, leaving about 11″ of surface to bear against the body. The bottom edges of the runners should be 3″ below the body. In other words the clearance of the body at the rear should be 3″. At least 3 bolts should be put through each runner.

Figure 6 gives a good view of the brake. This is constructed of two pieces of iron, or soft steel. One piece 30″ long by ½″ in diameter has its extremities bent at right angles making legs 4″ long. These are flattened as shown, and saw teeth filed to engage with the ice. To one of these legs is affixed the 1″ x ¼″ iron lever by means of rivets. This is brought to the bottom of the leg and affords additional surface to engage with. The upper end of this is rounded to fit the hand. This brake is attached to the bottom of the body 20″ from the rear by means of three stout brass straps. The lever is bent out to clear the side by about 3″ and when not in use is held against a small block by means of a spring as shown in Fig. 1, so as not to drag on the ice.

The next step is to select a good second-hand motorcycle motor of from 3 to 4 h.p. A motor in good running condition can be bought for $10.00 with battery ignition, and for about $15.00 with a magneto. This motor is mounted at the extreme rear of the sled, and is held firmly in position by two U-shaped iron supports, one of which is shown in Fig. 1. These supports should be about ¼″ thick by 1½″ wide, and should be high enough to elevate the motor so that the distance between the top rear edge of the body and the main crankshaft bearing is about 18″. This will require about 44″ of strap iron for each support, as these pieces must extend high enough up on each side of the crankcase to permit of two crankcase bolts on each side being passed through the supports, provided the engine in question has two bolts to a side, which is generally the case.

The controls on most second-hand motors are so different that it is practically impossible to give any method for rigging them up on the motor ice-boat. The simplest method, is to use flexible controls for the spark and gas, mounting the levers on the side of the boat near the brake handle, in such a manner that they do not come in the way when actuating the brake.

The next consideration in equipping the craft is to provide an aerial propeller of the proper diameter and pitch. So many things must be taken into consideration in designing a propeller for an ice-boat that it is practically impossible to submit any one design which will work at high efficiency on any motor ice-boat. In order to obtain the very highest efficiency exhaustive experiments with propellers of different dimensions would be necessary. However, for ordinary work an aerial screw having an over-all length of 3′ will be found entirely satisfactory. in Fig. 7, a design is submitted which will give good results with a motor of from 3 to 4 h. p. The greatest pitch of this propeller is 4′. This means that at every revolution the propeller theoretically advances 4′ and in practice somewhat less than 3′ if we figure the efficiency at about 70 per cent.

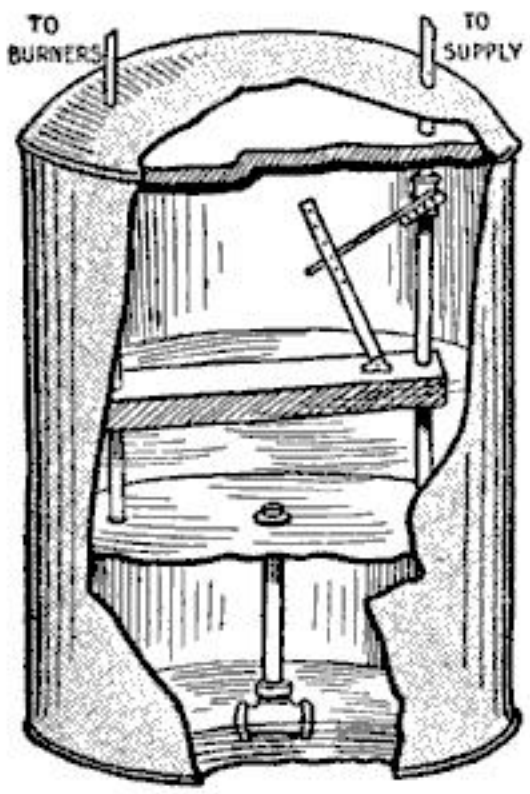
The exact dimensions for the propeller are indicated in the sketch. The cross-sections of the blades given show the size and angle every 3″ from the center to the tip. It will be noted that the under-surface of the blade is slightly concave, most of the cross-sections being semi-streamline in form. This propeller can be constructed of a 2″ by 6″ spruce plank slightly over 3′ long. Spruce is one of the best materials for this purpose and also the cheapest. Most of the work in turning out this propeller can be done with a small hatchet or a drawshave, and finished up with a spokeshave. The blades should be well sandpapered and given several coats of shellac. This propeller is bolted directly to the pulley or sprocket as the case may be, on the end of the motor crankshaft, with two ⅜″ bolts, the ends of which should be secured to prevent their loosening.

The machine which has been described will carry two passengers.

A Simple Gas-Pressure Regulator

A STEADY gas pressure is often desirable but seldom obtainable direct from the main. The writer, desiring to use gas as fuel for six small incubators, found the regulator shown in the accompanying diagram very simple to construct and extremely effective.

The tank used was a five-gallon, galvanized iron oil tank. The division shown is cut from a piece of galvanized iron and the pipes are fastened into place with locknuts and leather washers, before it is soldered into place, which should be about one-third the way up the bottom. The center pipe is 1¼′ standard and extends to the bottom, forming a conductor for the oil and a brace for the dividing diaphragm. The gas pipes are ½″ standard, and are fastened firmly to the wood brace at the top of the tank. The regulating valve is an ordinary gas cut-off with an extended arm riveted to its "T" lever. The arm which connects the valve lever with the float, is bored in a number of places, which allows for setting. This adjustment is necessary only once. The wood float has two 1″ holes bored through it as shown, and so uses the two gas pipes as guides. The weight of the float must, of course, be sufficient to operate the valve, which may be suppled up a little with laundry soap.

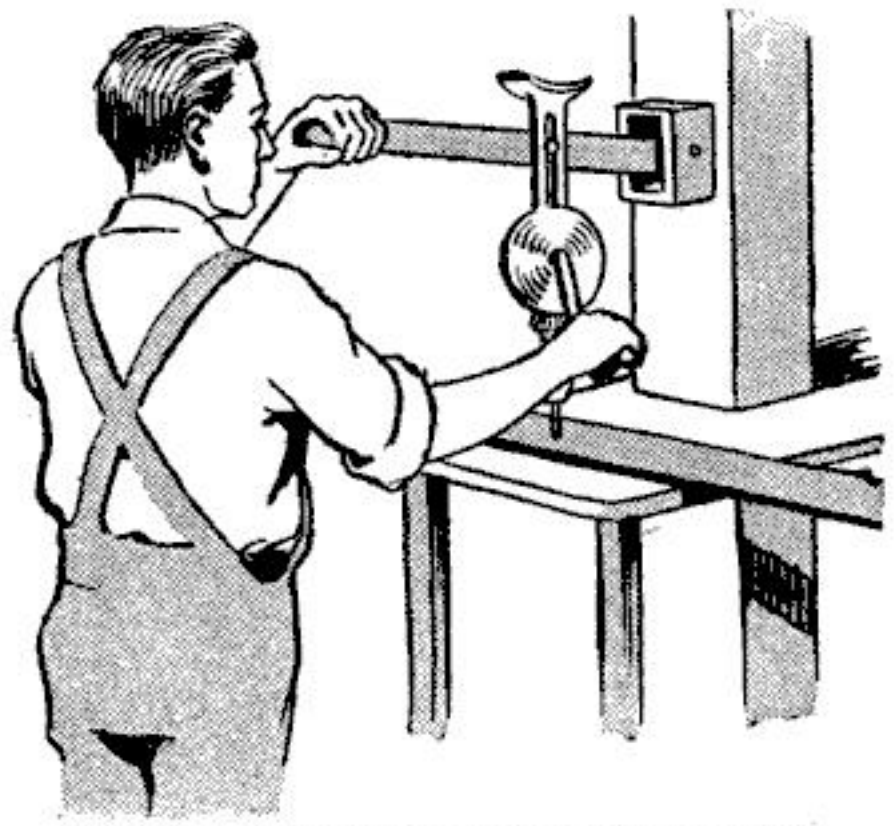


This simple device will regulate an uneven gas pressure from the main

Pour in enough thin, cheap machine oil to fill the bottom compartment and raise the float about an inch, set the valve about two-thirds open and turn on the gas. With no burners going, the float should rise so that the valve is nearly closed. With all burners going it should be an inch above where it stood before the gas was first turned into the regulator.—E. C. GRAVES.

An Emergency Drill Press

A DRILL press for emergency jobs can be made in a few minutes provided a breast drill is available. A

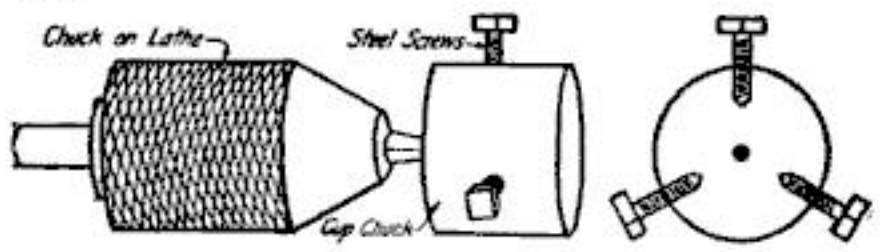


This emergency drill press is simple to rig up, and will be found very useful

wooden arm between two and three feet in length should be pivoted at one end to a wooden support that is fastened by nails or screws to a stout base. A few inches from the pivot, a bolt should be inserted through the arm and the handle of the drill. Place the lever under the left arm; manipulate the drill with the hands.—N. S. MCEWEN.

A Handy Chuck for a Small Lathe

A CHEAP and useful chuck for a polishing lathe, can be made as follows: Cut from a 1½″ brass tube, a piece about 1″ long. File the edges true and solder at one end a fairly thick disk of brass. In the centre of this, drill a hole and insert and solder a short length of steel shafting, which will serve as a grip for the drill chuck when mounted

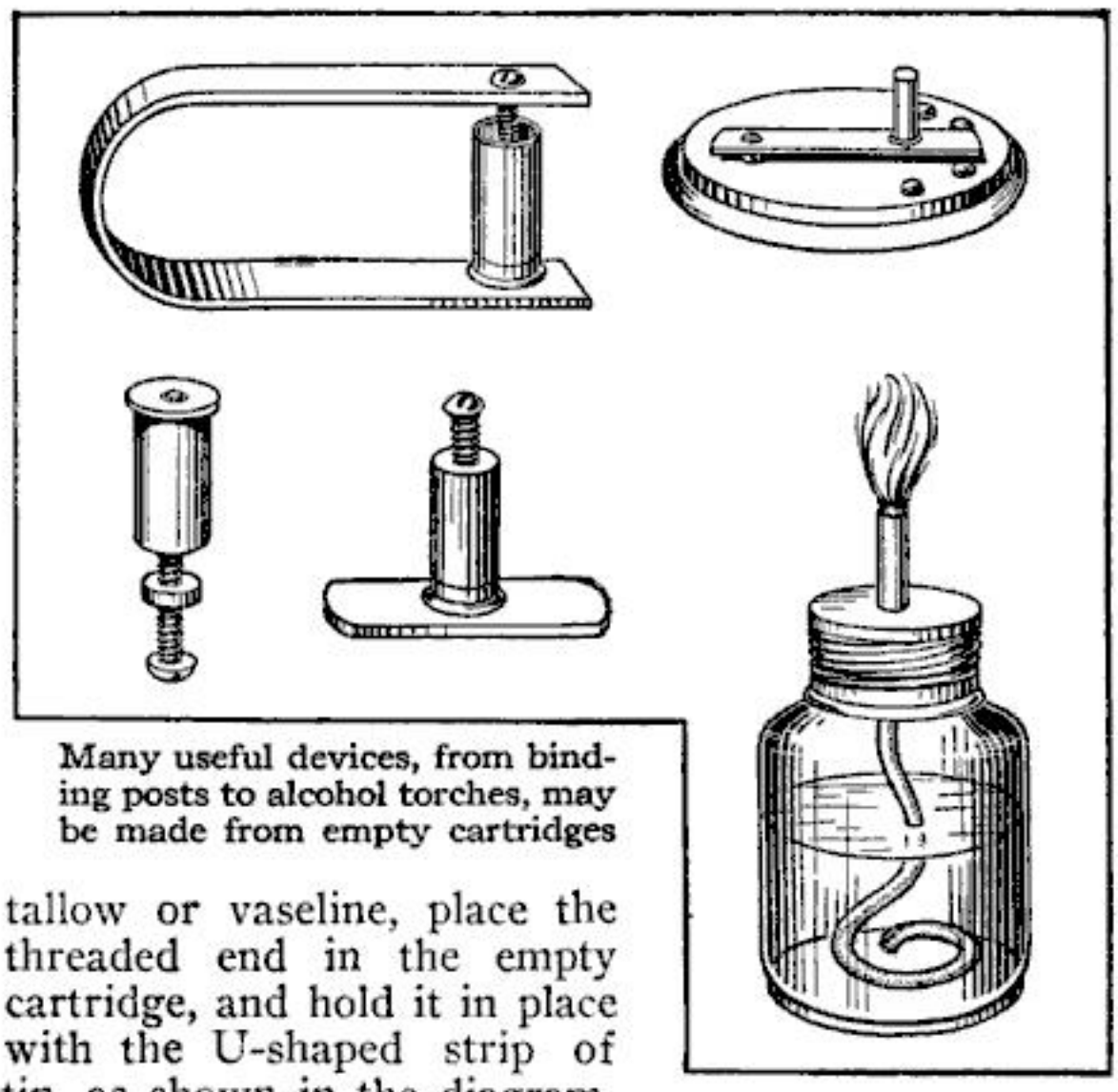


A good substitute for a scroll chuck

on the lathe. At equidistant points around the circumference of the cup, drill and tap to fit three steel screws. The article to be turned is held securely by the screws.—H. VINCENT.

Utilizing Empty Cartridges

VERY good binding posts can be made from empty .32, .38 and .44 caliber cartridges and stove bolts in the following manner: Grease the stove bolts with tallow or vaseline, place the threaded end in the empty cartridge, and hold it in place with the U-shaped strip of tin, as shown in the diagram. Now fill the space between the bolt and the cartridge with melted lead or babbitt metal. When the lead has hardened, remove the strip of tin, and unscrew the bolt from the lead. By drilling a small hole through the cartridge, and soldering a small strip of brass to the bottom to permit its being fastened to the desired base, an inexpensive and handsome binding post is ready for use.



Many useful devices, from binding posts to alcohol torches, may be made from empty cartridges

A good alcohol torch can be made from a vaseline bottle and a rim-fire cartridge as follows: Make a hole through the screw cap of the bottle large enough to admit the cartridge. File off the closed end of the cartridge, so as to produce a short tube with a flange at one end. Insert this through the cap, to which it should be soldered. The wick is led through the tube from the bottle, and the entire outfit forms a serviceable torch.

The Thermos Bottle as a Stove

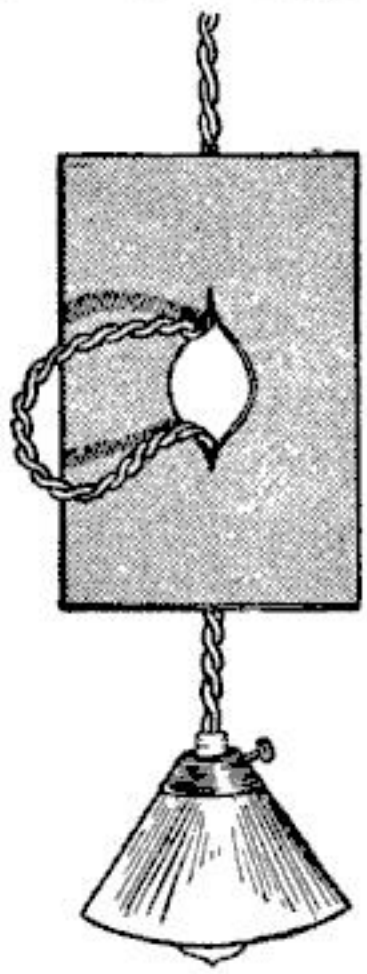
IT is perhaps not generally known that the smallest fireless cook-stove is any one of the numerous vacuum bottles which have been on the market so long. In most families these are regarded as a convenience or luxury for picnic purposes. They really make a very useful fireless stove.

Heat soup, beans, peas, or any other vegetable that will go through the rather small opening of the bottle, leave them there for several hours, and they will come out completely cooked. The many uses of vacuum bottles are by no means exhausted by the one just mentioned.

To Adjust a Light-Cord

IT is often difficult to adjust the electric drop-wire quickly and at the right height by tying knots in the cord, and worse still to untie these knots and put new ones in, when the light is to be moved. The wires also become dirty after they have been up some time, and if one undertakes to change the light the result is a pair of soiled hands.

A piece of good stiff cardboard, about the size of a calling card, and a sharp pen knife complete the list of necessaries to make a cure for this evil. Cut a diamond-shaped hole in the cardboard and draw the wire through the middle of the hole. When you have the light at the proper place, push the twisted wire towards the bottom and top of the slit, and the weight of the fixture and globe will prevent further slipping. There is no knot here and if it is desirable to move the light again you can do so, without any trouble, and in a minimum time.



A piece of cardboard and a knife make tying knots unnecessary

Experimental Electricity

Practical Electrical Hints for the Amateur
Wireless Communication

Safeguarding Vessels by Radio

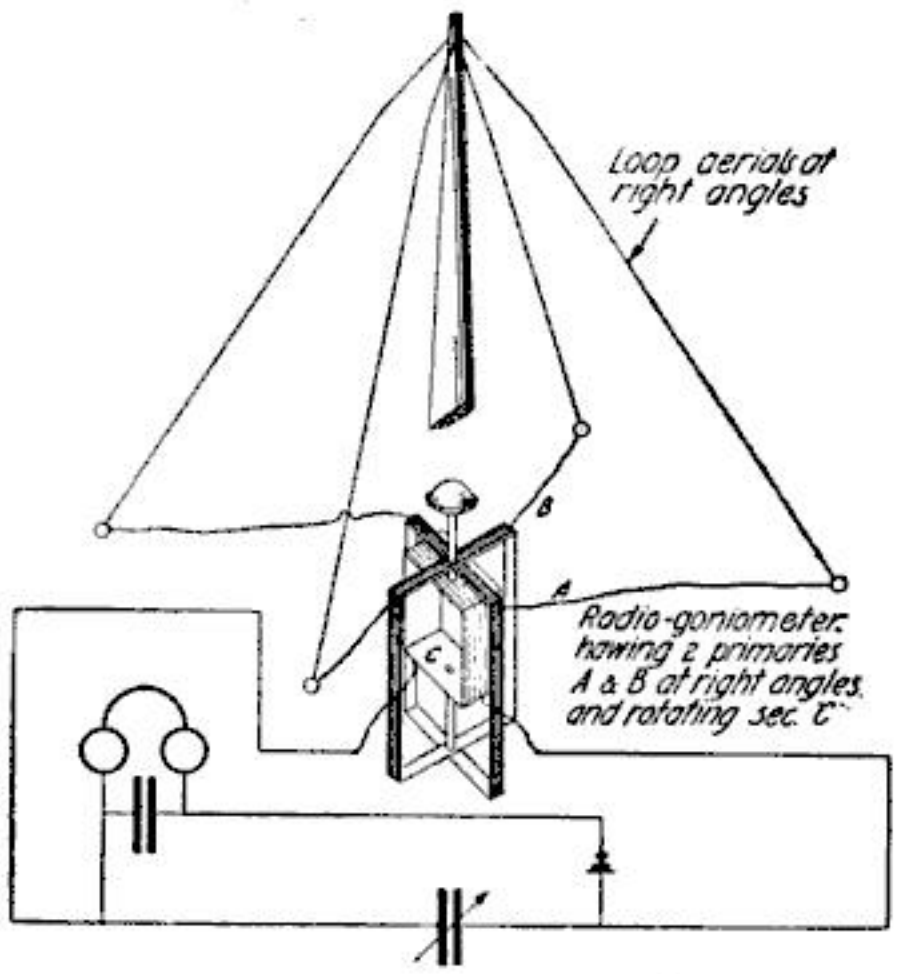
By Annis Salsbury

ONE wreck a day is said to be the average on the fog-visited Pacific Coast. Commerce on the Great Lakes, while possible during only half the year, is exposed to dangers inherent in waters visited by dense and persistent fog. Likewise, the Atlantic Coast is not without this menace to navigation, for it runs a close second to the Pacific in the number of its sea tragedies; the Gulf of Mexico is also frequently blanketed with mist, and there the dangers of collision or grounding on coral reef or sand bank are much increased.

The United States lighthouse service has greatly lessened the death toll of treacherous points, but even a beacon of a million candlepower or the shrillest fog whistle is powerless to combat fog. Sound, unreliable under even the best atmospheric conditions, is refracted and reflected to a marked degree by fog-banks, fog-waves and fog-billows. Fog blots out the bright rays from a lighthouse as completely as if it were swathed in thickest wool, and the mariner who is unfortunate enough to find himself on the sea under these conditions, unable to sight a warning beacon, and not trusting fog-siren or booming rocket, flounders about as helplessly as a blind man on a busy street. Fog is without doubt the greatest menace to safety known to navigation, and any means of enabling a mariner to keep his course in fog and to receive timely warning of the proximity of other vessels will relieve ocean travel of its chief danger.

Scientists in the United States, thoroughly cognizant of this fact, have for some time been on the trail of devices calculated to overcome this peril of the sea, but not until recently have practical suggestions been put forward for the relief of this age-old menace.

The "radio compass," which promises to add much to the safety of navigation, has been in use in Europe for several years. It is said that ships have found their way up the river to Hamburg in the densest fog, and that Zeppelins depend entirely on stations fitted with this special apparatus during darkness or when the earth and its familiar land-



Wiring diagram of the Bellini-Tosi directional receiver

marks are blotted from view by mists or fogs. The French government, as well, has made it possible for ships, fitted with the compass, to determine their positions through wireless signals from the stations along the coast.

The United States Radio Service is now experimenting with the Bellini-Tosi type of radio compass at Cape Cod and the Telefunken compass at Fire Island. The purpose of each is to enable the navigating officer of a vessel to take bearings of wireless telegraph stations, in order to find the position of his ship or to avoid collision with other craft. It is not asserted that the bearings taken exceed, or even equal in accuracy, those taken with an accurate optical instrument under favorable conditions, but reliable bearings may be obtained by radio, when direct optical bearings may not be taken because of unsettled weather, etc., and in making harbors, in keeping to difficult channels, and in avoiding collisions with other vessels, when fog obliterates surrounding objects from view.

Transmitting Distributors of the Telefunken Compass

Both compasses are modifications of the same principle. The Bellini-Tosi type provides that the moving station, whose position requires determination, shall send signals to a fixed station. The direction of receipt is determined at the fixed station, and then transmitted by wireless to the moving station. In the Telefunken system, the fixed station sends out signals and the moving station determines from what direction they are coming. In both arrangements it is necessary that one of the stations should be directive.

Directive sending is accomplished by special antennas, which are considerably more complicated than those of the ordinary undirective type, require greater space, and are difficult to install on movable stations, such as ships or aeroplanes. The system in which fixed stations send out directive signals, therefore, appeared most feasible to German inventors. In this case the movable receiver need only be equipped with an ordinary antenna. The Telefunken compass is so worked out, then, that it may be installed only on shore. Some thirty-two transmitting antennas are disposed at equal distances around a circumference of a circle 200 meters in diameter. Each pair is joined up successively with the transmitting apparatus by a rotary distributor, and at each position a signal corresponding to a point of the compass is sent out. An operator on board ship thus hears a succession of signals, increasing gradually in strength to a maximum and then dying away. The loudest signal occurs at the moment the shore operator is sending on the antennas pointed in the direction of the receiver. All that is necessary for the ship operator to do, then, to obtain the bearing of the land station, is to note the signal that is strongest.

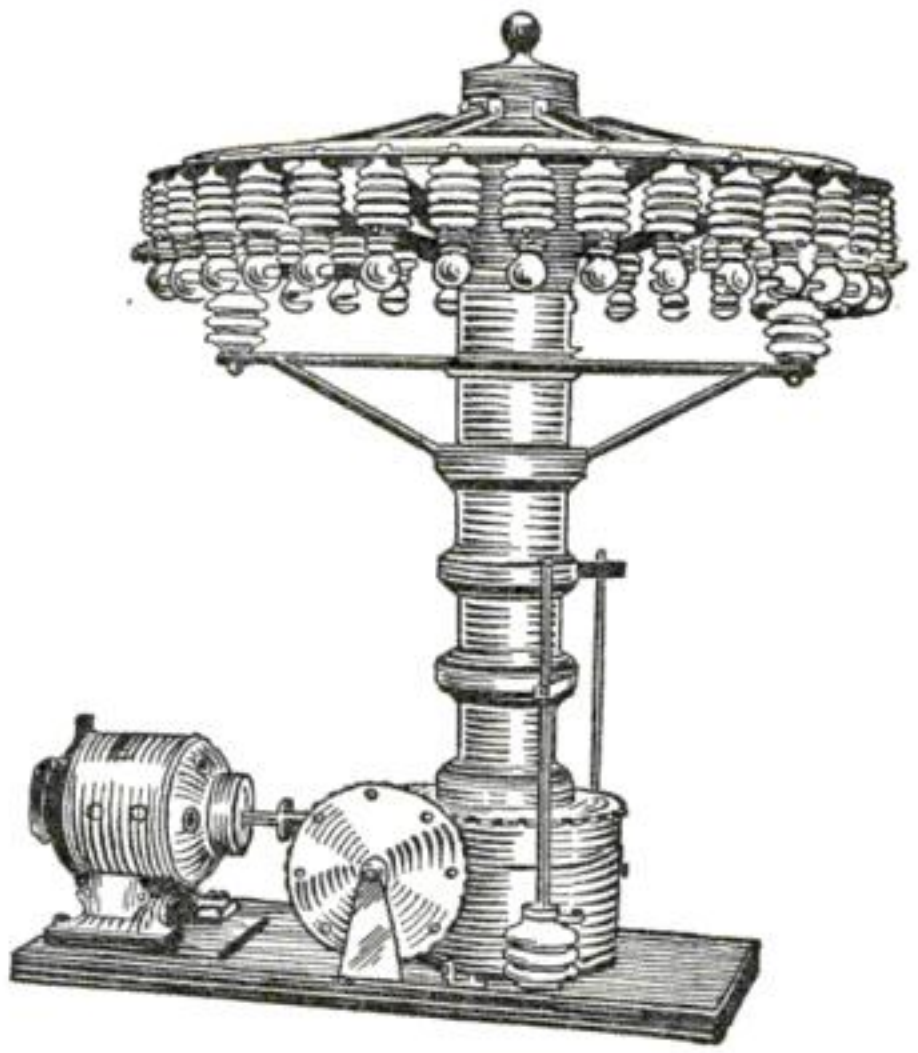
On the other hand, the Bellini-Tosi arrangement is contrived so that it may be installed on shipboard. The ship thus fitted is enabled to get its bearing from any wireless station on the coast or inland, if within range of the ship's wireless. The salient features of the Bellini-Tosi system are two aerial loops of equal size, suspended in vertical planes crossing each other at right angles, and a "radiogometer" or special receiving transformer, having two primary coils of equal size and crossing each other at right angles in vertical planes. When a signal is received, currents are induced in both aerials, their relative strength depending on the direction of the sending station with reference to the planes of the two aerial loops. The signal is loudest when the plane of the aerial loop is the same as that of the sending station, weakest when the planes are at right angles. The induced currents pass through the corresponding crossed coils in the instrument and produce, in the space enclosed by them, two magnetic fields at right angles to each other. The two fields have relative strengths depending on the relative strengths, depending on the relative aerials, and they combine to form a resultant field at right angles to the direction from which signals are coming. The pivoted secondary coil will consequently receive the strongest signals when its plane is in the direction from which signals are coming. A pointer at-

tached to this secondary or "exploring" coil indicates its position and consequently the direction of the sending station.

A useful application of the direction finder is the determination of whether the ship is on a course which will take it inside or outside a lightship or isolated lighthouse. A few signals from the fixed station will settle the question as certainly as if the light were visible. Similarly, when making a harbor, a few signals from a station within will show immediately whether the ship has drifted to one side of the entrance. When trying to locate another vessel in a fog, the indication of the direction finder may show, by a steadily increasing strength of signal, that the other ship is approaching, but, since only the direction and not the sense is given, it might leave doubt as to whether it was approaching on the port bow or the starboard quarter. A wireless query as to her course, addressed to the other ship, would remove the doubt at once.

Following out the German idea and installing the compass on shore, relieves the ship of a special aerial, but the point against it is that there must be numerous coast stations fitted out with the transmitting apparatus. The Telefunken device is used along the German coast, however, and at the outbreak of the war, comprehensive schemes for installation at intervals of every 25 miles along the northern and western coasts were about to be carried out.

United States Government engineers, working from a slightly different angle, have suggested a plan which they believe will greatly reduce the fog peril and yet require minimum investment in men and money. It is merely a wireless transmitter, fitted with an automatic sending device, and calibrated to send only a limited distance. This radio fog-signal may be installed with equal facility on shipboard or at a land station. The antennas are of the simplest type, and the automatic transmitter makes it possible for any person to operate it. A ship making its way along the coast in a fog may hear some lighthouse in his vicinity, equipped with the radio fog-signal, sending out a pre-arranged series of signals, characteristic of that particular lighthouse. The captain then knows that he is within ten or twelve miles of that particular point. His position is further fixed as the ship proceeds, from the change in intensity of the signals, since, if the signals increase in strength, the captain knows that he is getting nearer the source of transmission.



The transmitting distributor of the Telefunken compass

A bad coast may be fitted with the radio signals at intervals close enough so that the coast-wise vessel will pass directly from the jurisdiction of one to that of the next. In this way there will be continuous protection for the ship. Installed on shipboard it may prove a valuable means of keeping vessels from crowding on to one another. The radio fog-signal is not a direction finder, but is to be merely a warning to ships passing along a dangerous coast, or an inexpensive addition to ship's equipment which way be used in time of fog.

The Earth's Conductivity

THE resistance of sea-water is only about one-hundredth that of fresh water. Damp earth often offers less resistance to electric current than does fresh water, but dry earth measures over ten times as many ohms between opposite sides of a cubic section.

Finding the Positive Wire

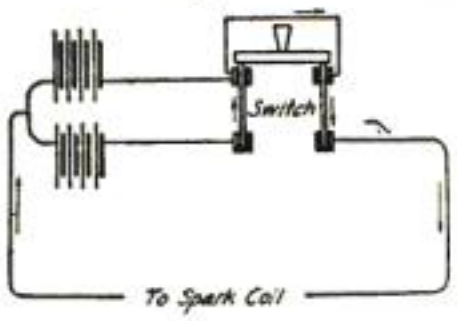
AN easy and simple way to find out which wire from a storage battery is positive and which is negative is the following:

Take a glass tumbler and draw some of the electrolyte from the battery, filling the tumbler about half full. Take two strips of clean lead and attach them to the two wires. Drop the leads into the solution, suspending them free in it, and switch on the current. After two or three minutes turn off the current and examine the pieces of lead. The one attached to the positive wire will be covered with a fine brownish deposit, while the negative end will be clean. The illustration herewith shows the arrangement.

How to Prolong the Life of Battery Cells

BATTERIES used for gas engine ignition are usually connected in series parallel, or, in opposition. This is the best method of connecting them, since a larger current can be obtained.

One disadvantage in this method of connecting cells is that, if the cells are left in opposition when not in use, they very quickly "die." The accompanying diagram shows a handy method of connecting cells so they will be in parallel only when the switch is closed. When the switch is opened the parallel connection, as well as the external circuit, will be broken. The arrows indicate the direction of the current when the switch is closed.

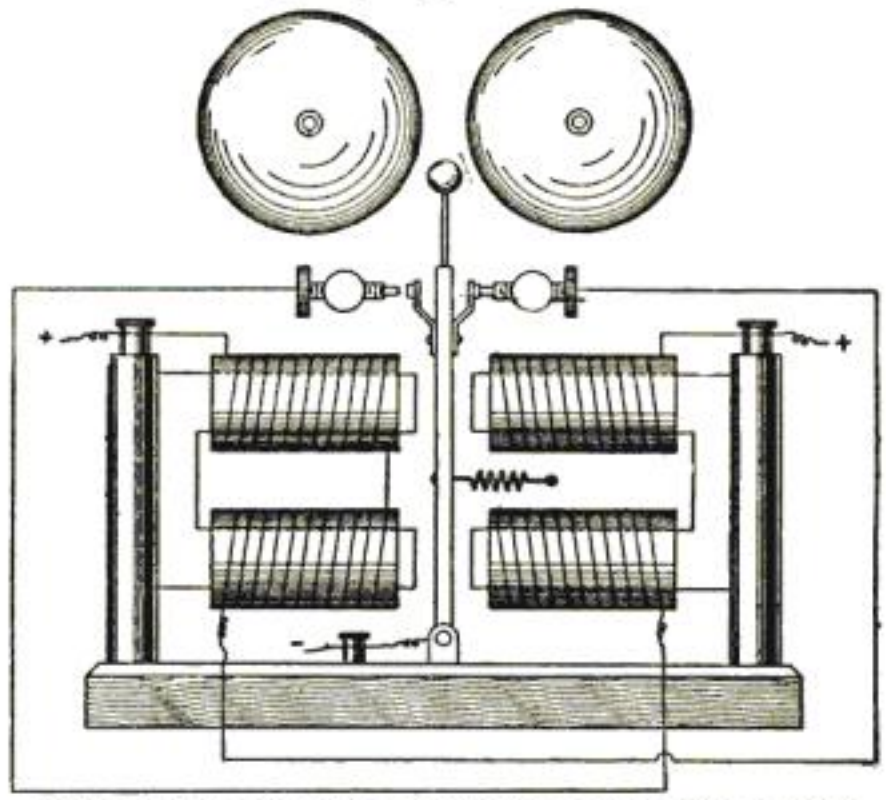


The Obligation to Secrecy.

ALTHOUGH the United States Government does not require experimental radio receiving stations or their operators to hold Federal licenses, the law as to secrecy of received messages is enforced upon them. This law states in effect that no persons shall divulge or publish the contents of any radio messages received or known by them, and provides a fine of $250 and three months imprisonment for violations.

Springless Electric Bell

AN electric bell can be made which will operate without springs, by installing the armature between two opposed sets of magnets. The resistance of opposing sets of magnet coils should be equal, about 150 ohms when the bell is operated on low voltage, and 200 ohms when a higher voltage is used. The diagram of necessary connections is shown in the accompanying illustration.



The action of the magnets makes the use of springs unnecessary

Photographic Records Still Impracticable

HIGH speed automatic wireless telegraphy in which a photographic recorder is used for the receipt of messages has often been attempted. Under favorable conditions signals of a moderate strength can be recorded at 80 or 100 words per minute, but presence of the slightest "static" makes great trouble. Even normal static, as it is heard during the summer in Northern latitudes, is sufficiently troublesome to make practical working impossibile. Other methods, such as those using phonographs or telegraphones, for recording the incoming signals, have proved successful over moderate distances. The large number of messages which can be sent in a short time by automatic working makes the problem attractive to radio companies.

A Simple But Powerful Arc-Light

THE arc-light shown can be made from odds and ends at a very small cost and can be used for many different purposes.

A piece of wood for the base, some strips of brass, a few battery binding posts, screws, drop cord and plug, and two battery carbons in a fruit-jar, with a small piece of fiber insulation, are all the articles needed to construct the light.

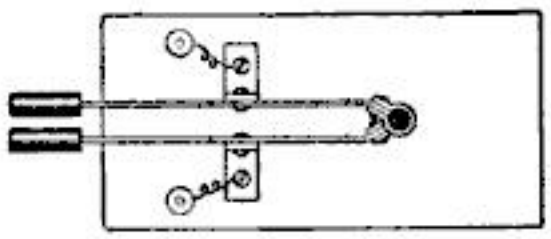
The fruit-jar resistance is the novel feature. Two ordinary battery carbons are held at a fixed distance from each other by two strips of fibre, the bottoms being about 1/8-inch and the tops 3/8-inch apart.

Rubber insulation cut from an old baby buggy tire may be used for handles at the ends of the strips holding the arc carbons. By moving these handles the arc may be raised or lowered and fed together.

After the wiring is completed, fill the jar 3/4 full of water and connect the plug with a regular 110 volt house light socket. This will make it necessary to put heavier fuses in the fuse block.

This arc will melt any substance placed between the carbons, as it will give from 1/4 to 1 inch flame.

If a housing is placed over the base,



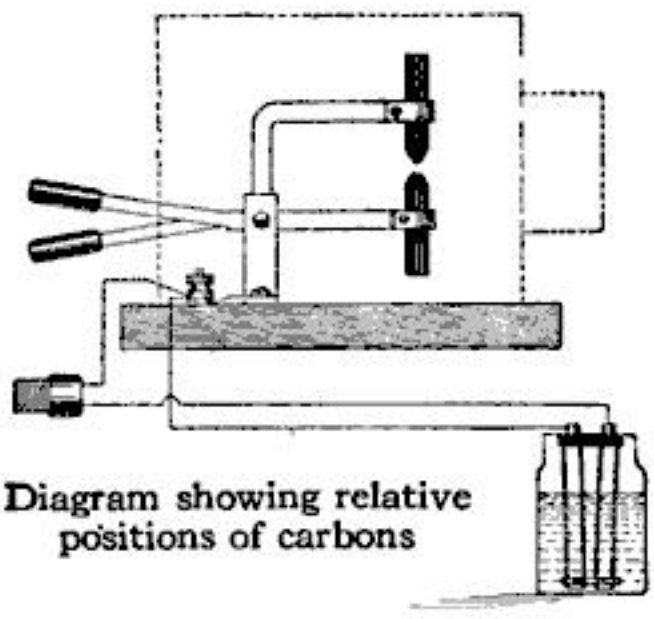


Diagram showing relative positions of carbons

as shown in dotted lines, and a reflector used with a common reading glass in the sleeve, the arc will cast a light the distance of a mile.

An Electric Heater in the Garage Makes Cranking Easy

THE problem of cranking an engine on cold mornings is one of the irksome tasks that still confronts the owner of automobiles. Radiators filled with

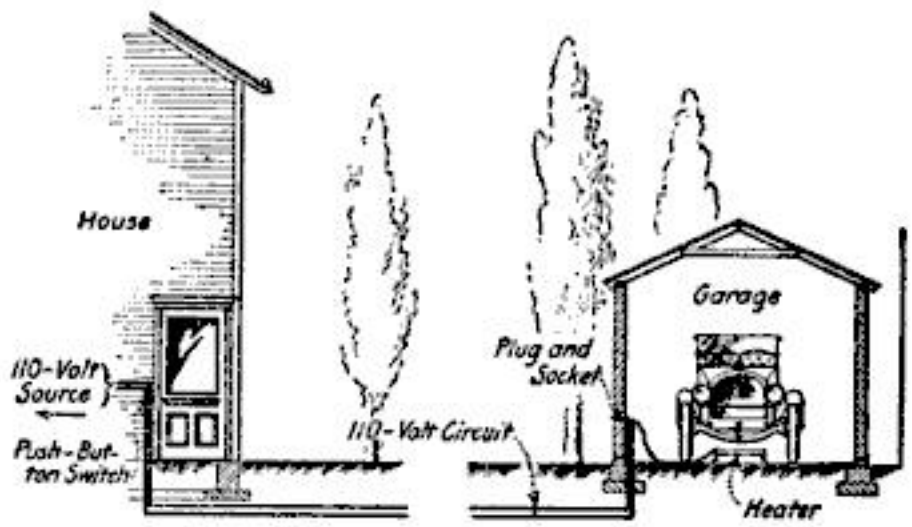


Diagram of wire connection with heater

an anti-freezing mixture will resist very low temperature without congealing, but if an engine is idle over night, all the working parts become so cold that a great deal of energy must be expended at the crankshaft before even a sputter of encouragement comes from the exhaust muffler. This can be avoided by the use of a 500 watt electric air-heater. The circuits to feed the heaters can be wired, as shown in the diagram.

About half an hour before the owner is ready to use his car in the morning, he turns the switch, which is located inside the house, and the heater in the garage begins to warm up the engine and the fluid in the radiator. As he leaves the house he disconnects the heater from the line; but by this time the engine, radiator and carburetor are warm, and at the first turn, a liberal charge of gas is exploded in the engine cylinder and the car is ready for work.

The Wireless Idea Is More Than Seventy Years Old

NEARLY eighty years ago the first patents on wire telegraph systems were issued, in England and America. The first suggestion that wires might be eliminated came only a few years after the beginning of line telegraphy, and although "wireless" telegraphy by conduction was practiced experimentally in 1842, it was not until 1895 that radio telegraphy was first accomplished.

Recent Radio Inventions

Microphonic Relays; An Unusual Quenched Spark-Gap; a Slipping-Contact Detector

By A. F. Jackson

FOR a number of years inventors struggled to produce microphonic relays, but their work was practically without substantial success. It was not found possible to build an instrument which would magnetically modulate the current through a microphone contact in such a way that all the vibrations of the human voice could be reproduced and magnified. This, nevertheless, did not prevent the development of microphonic relays that would augment the energy of current having a single definite frequency. Instruments of this sort are shown in 1915 U. S. patent No. 1,163,180, issued to W. Schloemilch and A. Leib.

One arrangement of this patent is shown in Fig. 1. The antenna, tuning and rectifying system *a, b, c, f,* leads the converted, pulsating energy of the received waves to the first amplifier *d1*. This consists of a wire vibrating system *g1* connected mechanically to a microphone *h1*. The tension of the vibrating wire is variable, and is to be adjusted so that its mechanical period is the same as the sound period of the incoming wave groups. Thus the wire is made to vibrate, through resonance, and a great effect is produced upon the microphone. The current from battery *k1* is varied by the first relay and led through the magnets and the second-step relay, which controls the current from a second battery. The second step of amplification is carried into the third relay and its output through switch *m* either into the loud-speaking telephone *n* or into the delicate contact relay *p*, the final relay *o1*, and the Morse printer *o*. The relay *p* is not of the microphonic type, like those of the first three steps, but has a tuned wire *p1* in contact with a sluggish spring *p2*.

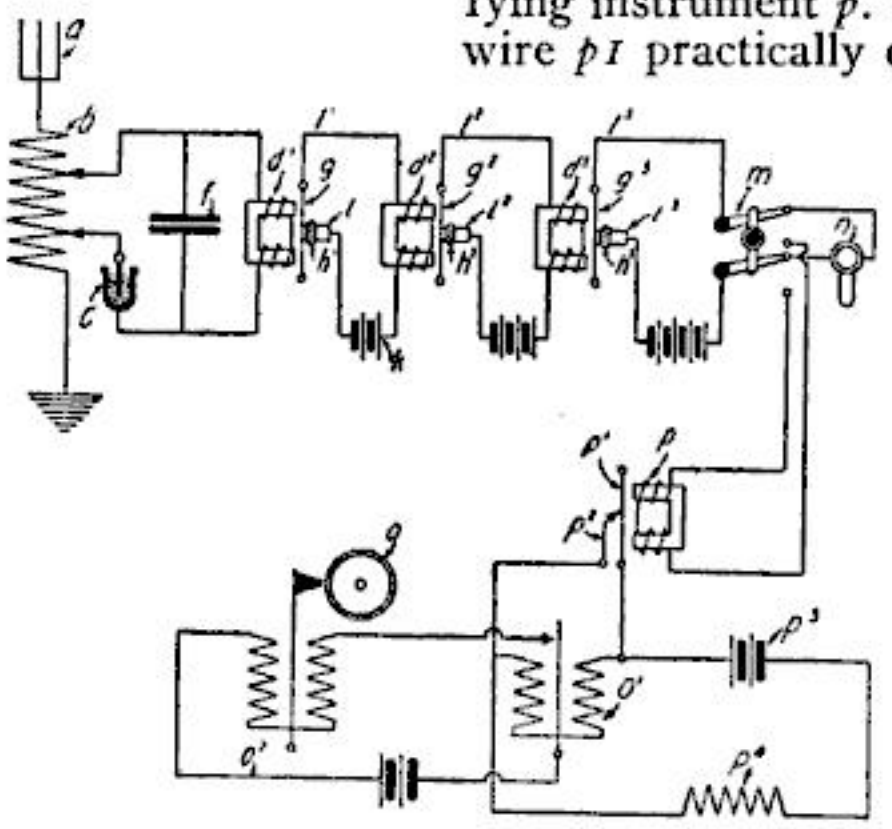


Fig. 1. With a microphonic relay of this sort, tremendous magnifications may be obtained

When signals are received of the group frequency to which all these relays are attuned, the third-step relay sends a strong current into the intensifying instrument *p*. The vibrations of the wire *p1* practically open the local circuit of this last named apparatus and so permit the final relay to close and the Morse printer to register. This same microphonic amplifying apparatus may be applied to sustained-wave reception, if an interrupter is inserted at either the sender or receiver; in this case, the vibrating wires are tuned to the interrupter frequency.

In the same way, beats or heterodyne receivers may be used, and the relays tuned to the resulting signal frequency. With apparatus of this kind, tremendous magnifications of signals may be obtained; the microphonic relays must, however, be protected from vibration and kept in accurate adjustment. In place of the intensifying relay *p*, a transformer and rectifier may be used to make the amplified alternating currents operate a direct-current relay.

By the combination of large amplification from the microphone relays, connected in cascade, with exceedingly sharp resonance to tone frequency, some extremely interesting results have been secured. Using a single receiving antenna, tuner and detector, it has been found possible to record, on separate Morse tapes, messages from three different transmit-

ters, sent simultaneously on the same wavelength. Each sender used a different spark frequency, and three banks of relays, such as those described, were connected in the telephone circuit of the receiver. Each of the relay-groups was mechanically tuned to the tone-frequency of one of the senders, and therefore responded to signals from that station only.

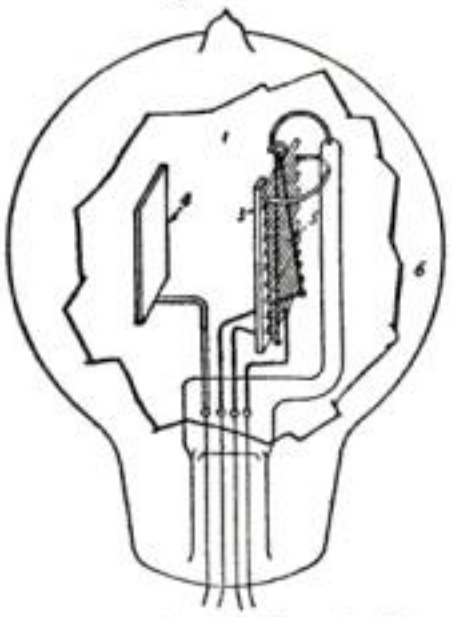


Fig. 2. An audion bulb of high voltage

The use of group-frequency tuning, in addition to the ordinary wavelength tuning, gives a vast number of combinations for the reduction and prevention of interference. The practical difficulty is that "static" is amplified along with the messages, and, what is most unfortunate, produces a ringing, musical sound. This of course makes it all the harder to read the signals.

Patent No. 1,129,942, 1915, issued to H. D. Arnold, shows a form of audion tube of increased efficiency. It is found possible, by varying the location of the plate with respect to the grid and filament, and by altering the form of the grid, to build audion amplifiers in which the magnified energy is characterized either by high voltage or high current. A bulb of the high voltage type is shown in Fig. 2, in which the grid 3 consists of fine wire and is placed close to the filament 5. The plate 4 is set at some distance from the grid-filament system and the whole is enclosed in the usual evacuated bulb 6. The patent referred to deals especially with various combinations of these high and low voltage amplifiers for line telephony; nevertheless, the use of similar instruments for both radio transmitters, amplifiers and receivers makes the design of interest.

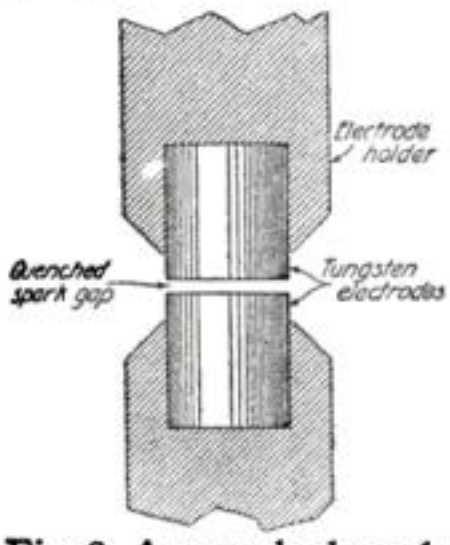


Fig. 3. A quenched spark gap of unusual construction

A quenched spark-gap of unusual construction appears in Fig. 3. Small tungsten buttons, having parallel faces, are set into brass or copper electrode-holders, and set with their parallel faces very close together. A number of these gaps, each operating in open-air, are connected in series to make up the complete quenched-gap system. With gaps of this type, on account of the very high melting point of tungsten, the two electrodes can be adjusted very close together without any great likelihood of short-circuiting through oxidation. Also, since tungsten is practically unburnable, the diameter of the electrodes may be made very much less than in the ordinary quenched gaps. The inventor states that little difficulty is experienced in getting pure spark-tones when the tungsten electrodes are used, because of their constancy in operation; it is pointed out that even with incorrect coupling values, the spark tone remains good. Oscillation circuit couplings of as high as 45 per cent, giving extremely high quenching, may be used. The drawing is taken from 1915 U. S. patent No. 1,152,272, issued to H. Boas.

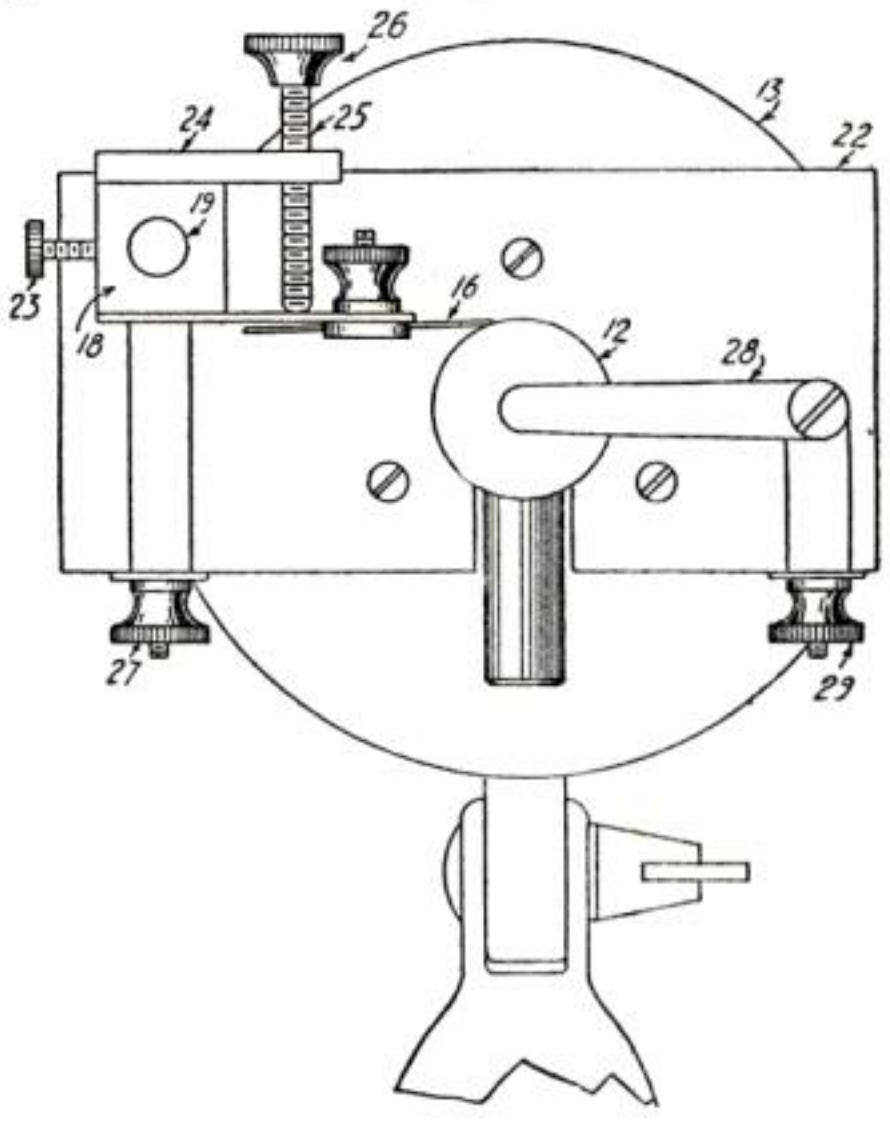


Fig. 4. Diagram of the slipping-contact detector for radio telegraphy

A United States patent issued to C. V. Logwood, in 1915, No. 1,161,142, describes what has come to be known as the "slipping-contact" detector for radio telegraphy. This is shown in Fig. 4, and consists of a grooved conducting cylinder 12, which is rotated by a smaller motor 13 and has bearing upon its surface a delicately fine contacting wire, 16. This apparatus forms a resistance-varying device, which is connect-

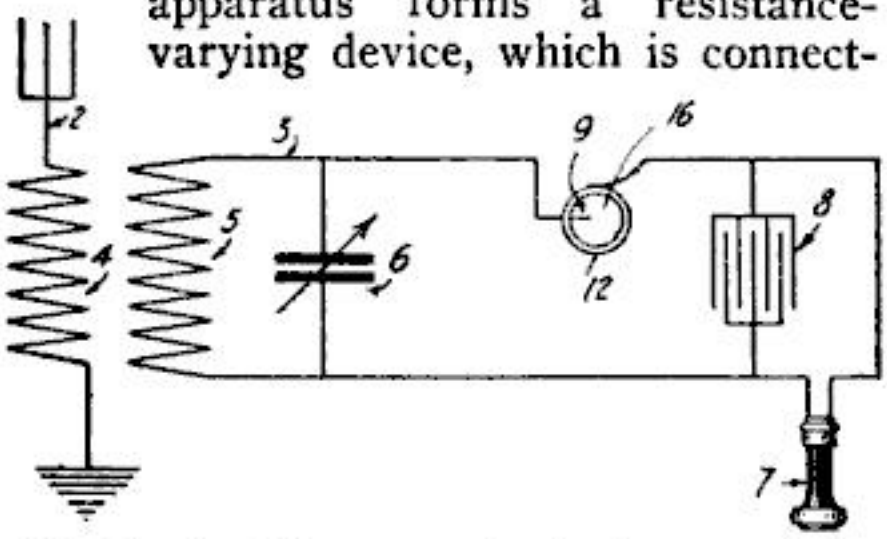


Fig. 5. A resistance-varying device connected into the receiving circuit

ed into the receiving circuit as shown in Fig. 5. Rapid irregular changes of resistance, or in some cases actual breaking of the circuit, result in permitting the large condenser 8 to draw an irregular charge from the condenser 6 in the oscillating circuit. The condenser 8 discharges through the telephone 7, and gives the hissing response to sustained or feebly damped waves that is characteristic of this form of receiver. The device has been found to be very sensitive as compared with a rectifier and interrupter for receiving sustained waves, and in addition has the advantage of drawing energy from the receiving secondary circuit at so small a rate that very sharp tuning may be obtained.

Patent No. 1,144,969, issued to G. W. Pickard, shows an interesting receiver for radio telegraphy and telephony. The circuit arrangement is shown in Fig. 6, where the antenna *A* is connected through an inductance *L1* to ground *G*. Coupled to this primary coil, which is tuned to the frequency of the incoming waves, is a secondary *L3*, shunted by tuning condenser *C2* and having associated with it the detector *D*, condenser *C3*, and telephone *T*. These elements form the usual receiver, which is tuned to the waves it is desired to receive; the present invention adds to this a closed oscillating circuit formed of coil *L2* and condenser *C1*. This third inductance coil *L2* has a variable coupling to the primary *L1*, and is used to create electrical beats in the receiving circuits by the peculiar coupling reactions which occur when the mutual inductance of the system is given the correct value. The inventor states, in effect, that when sustained waves are received, the primary and the closed circuits may be so related that the inducing and induced currents will react upon each other in such a way as to produce electrical beats or amplitude variations and at such frequency that they may be picked up by the coil *L3*. The receiver is of nearly equal value if the received waves are not completely sustained, but are only feebly damped; for highly damped, incoming energy, however, the device is practically inoperative. From the patent specification, it appears that this is a new type of receiver which will give variable musical responses to signals transmitted by spark or sustained-wave alternator-senders. The tighter the coupling between *L2* and *L1*, the higher the frequency of the beat-tones produced. The coil *L3* should not be very tightly coupled to the primary *L1*.

A modified form of quenched-gap sender is shown in Fig. 7, from U. S. patent 1,162,830, issued to G. Von Arco and A. Meissner. The invention is intended to permit heterodyne

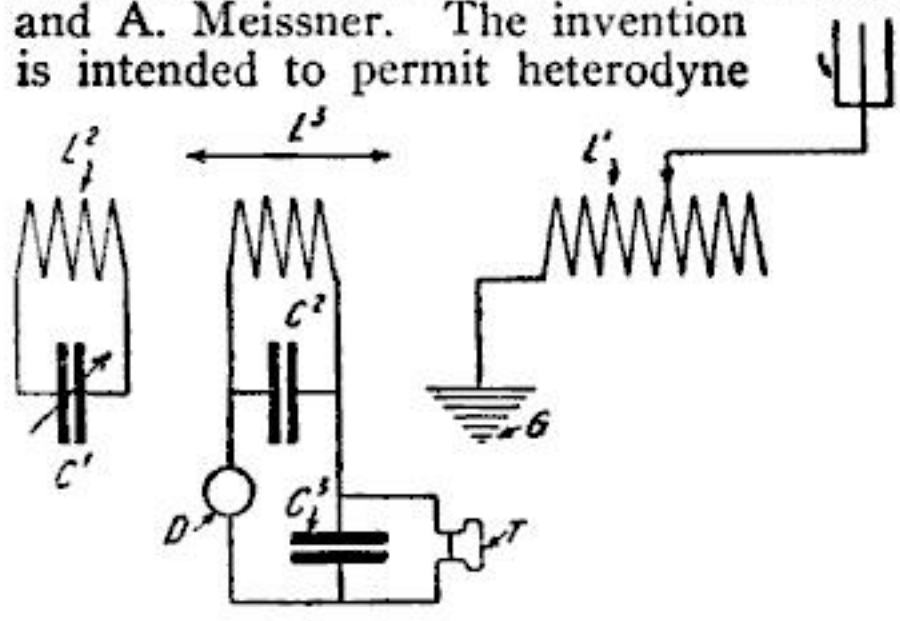


Fig. 6. An interesting receiver for radio telephony as well as telegraphy

or beats reception from spark-senders, without destroying the musical character of the signal note. As is well known, when a heterodyne receiver is used for producing sustained-wave signals, the tones produced are clear and perfectly musical; the same receiver, when translating signals from spark-senders, almost invariably gives a hissing sound instead

of the ringing musical tone which is so desirable. At one time it was thought that the increase in damping of spark signals, as compared to those of sustained-wave transmitters, was responsible for this change of note, but more recently it has been found that the difficulty arose through the constant changes of phase from group to group. If the train of waves produced by a single spark discharge continued until the next spark passed, and if the second spark occurred at just the right instant and in the right direction to keep its waves in exact phase (or so to speak, hand in hand) with those which were dying away, the beats-receiver would produce a musical tone instead of a hiss. The method of the present patent is directed toward producing this result.

Referring to the figure, the closed primary circuit *I*, including the condenser *1* and quenched spark-gap *2*, coupled to the antenna circuit *II*, is charged by power from the alternator *12* through lead wires *4* and *5*. A portion of the spark-gap is shunted by the closed circuit *III*, which comprises the secondary of transformer *8*, condenser *7*, and spark-gap *9*, with shunting-switch *13*. Transformer *8* serves to couple the controlling circuit *IV* with the ignition circuit *III; IV* includes one coil of transformer *15*, coupling it to the antenna. Primary and secondary of *15* may be short-circuited by switches *16* and *17*. Associated with the antenna is a closed pick-up circuit *VI*, which has coupled to it a rectifying-detector combination *VIII* and a local high-frequency-generator circuit *VII*.

The operation of circuits *I* and *II* is in accordance with the ordinary quenched spark-gap practice. Controlling circuit *IV*, however, acting through ignition circuit *III*, (and being of high persistence compared to the antenna), tends to regulate the recurrence of spark in the main gap *2*. With transformer *15* in operation, by opening switches *16* and *17*, the antenna *II* reacts upon and governs the controlling circuit *IV;* the conjoint operation of these various systems keeps the successive wave groups of the same phase and therefore, by continual reinforcement of the oscillations in the persistent receiver-circuit, results in a pure signal note in the heterodyne telephone. Thus it becomes possible to take advantage of the musical note for reading through static, in addition to the amplifying properties of the beats-receiver and the comparative simplicity of quenched-gap operation. The circuits *VI, VII, VIII*, form a beats-receiver used as a tone-tester at the transmitting station; when the outgoing wave-trains are held exactly in step by the controlling circuits, the telephone of *VIII* gives off a musical tone of the sort heard at the distant receiving station.

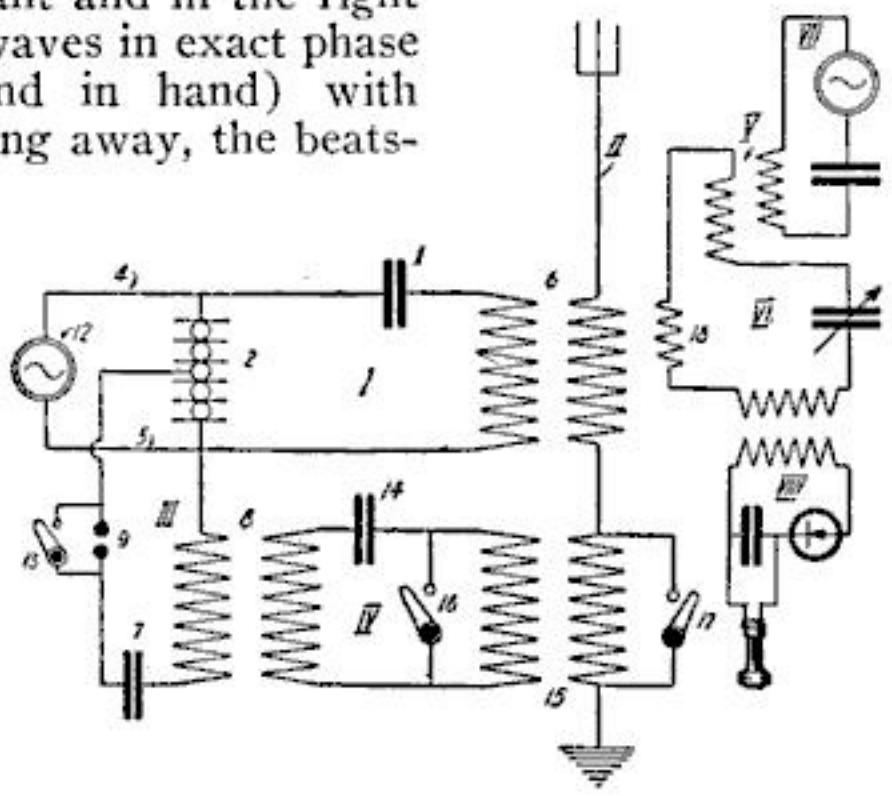


Fig. 7. A modified form of quenched-gap sender

ANNOUNCEMENT

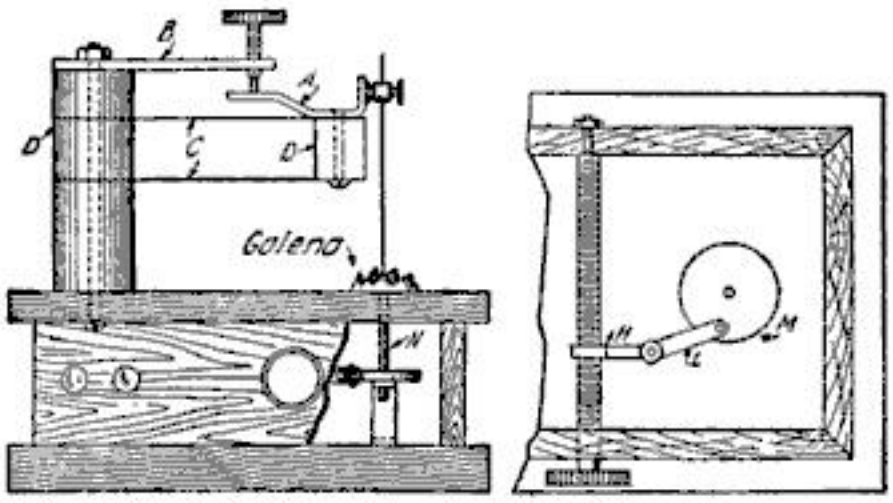
The time which must necessarily elapse before the publication in a monthly magazine of news of any sort has forced us to discontinue the department of "Radio Club News." The editor will, however, be interested to receive communications from Radio Club secretaries, and suggestions from them concerning the magazine and future articles.

An Improved Crystal Detector Stand

AFTER many years of scientific experimentation with various kinds of detector stands and contacts, the crystal detector stand described below was found satisfactory.

The detector is of the ferro type, mounted on a small box containing an arrangement for moving the crystal. The chief merit of the instrument lies in the use of a direct differential screw which insures perfect alinement.

This differential screw consists of a



Elevation and plan of a simple crystal detector stand

combination of an 8-32 screw and a 2-56 screw. It is made by drilling in the end of the 8-32 screw a hole to be tapped out with a 2-56 thread. A little patience is required, for if the builder does not center the hole perfectly the first time, he must try again. This is where the success of the instrument lies. A 2-56 screw is to be screwed tightly into this hole.

A hole should then be drilled in the piece *A*, directly below the one in the piece *B*, and tapped out for a 2-56 thread. When the differential screw is screwed in place and turned one complete revolution, it will lower 1-32″, but at the same time the piece *A* will be raised 1-56″ by the other screw, or in other words, the piece *A* will be lowered 3/224″.

The rest of the standard is easily made, as may be seen from the diagram, the pieces *A* and *B* being of 1/16″ brass, ½″ wide and of a suitable length. The pieces *C* are of thin phosphor bronze or brass ½″ wide and of suitable length, and the pillars *D* of round or hexagonal brass of any size to please the maker. The parts are held together with 8-32 machine screws.

A box of ¼″ oak about 5½″ by 3″ by 1¼″ should then be made, the detector being mounted centrally on the cover. Two binding posts are put on the front as well as the knob for the adjusting arrangement. As will be observed the adjusting arrangement includes a screw with adjusting knob, the screw running through the box, and the far end having the thread filed off and resting in a small hole bored in the back of the box. Jam nuts are used in back of the front piece to prevent the screw from coming out.

A small guide rod guides the piece *H*, which is moved by turning the screw. The rest of the arrangement can be seen from the diagram. The disk cup should be mounted eccentrically on the shaft *N* so as to obtain a greater range and contact for the mineral. The hole in the top of the box should be small enough so that the mineral will be held firmly. The standard and mineral adjusting device are connected respectively to the two binding posts.

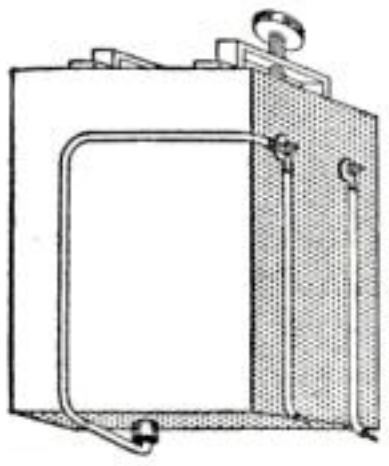
For a contact wire, a piece of very stiff German silver or other resistance wire (not iron) should be used, and heavy or light contact can be made with the point. No. 30 B. & S. is all right.

Loose-Coupler Switch Arrangement

AMATEURS often wonder how they can reduce the number of taps on their loose-coupler and still tune accurately. The following scheme has been used successfully and it is found that it not only saves money but the instrument works more easily. Instead of tapping every wire in the first ten and then every tenth wire, a tap is taken from every *second* wire in the first *twenty* and after that every *twentieth* wire. Thus half of the taps are done away with on the second switch. This, of course, only tunes in steps of two. To remedy this a separate single turn is added at one end of the primary and arranged with an extra two-point switch, so that this turn can be used whenever needed. With this arrangement, any possible number of turns may be used and the trouble and expense of making several extra taps are saved. Another advantage is that rough tuning can be accomplished much more quickly and, after a station is located, the more accurate tuning can be done.

Making a Master Vibrator for Automobiles

THE ignition of any motor car equipped with a vibrating coil may be greatly improved by the insertion of a device known as a "master vibrator" in the circuit. It is very difficult to adjust the separate vibrators for each cylinder, so that sparks of the same intensity are produced in each of the cylinders; but by substituting one vibrator for the several originally used, this difficulty is overcome.



The master vibrator as completed

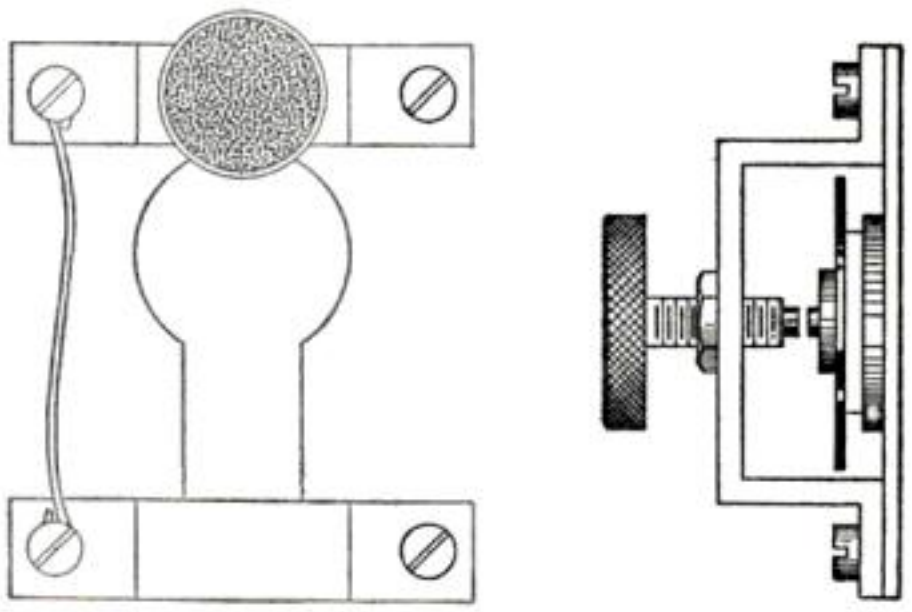
A discarded unit coil may be secured from any garage or second-hand parts house, the only requirement being that the vibrator on the end of the coil shall "buzz" when current is passed through the terminals. It is not necessary for this coil to deliver a spark. Hence the condition of the secondary winding is unimportant. A single coil which has been removed from a set of two or more, will prove very satisfactory, the box not being required.

This coil will have three terminals, two for the battery current and one that led to the spark plug. Connect four or five dry cells, as shown, and touch the two wires to any two of the three terminals until a pair is found which causes the vibrator to operate. Connect either one of the two terminals just found to the third (the one that did not cause vibration). This short-circuits the secondary winding of the coil, and makes it inoperative. The two terminals which did cause vibration are to be used. If this coil has no protecting box, it will be best to make one of a size that just takes the coil, with a cover hinged or screwed on over the vibrator end. The two terminals to be used should be brought to the outside of this box, preferably through the end opposite the cover, and the box containing the coil should then be mounted solidly on the dashboard by the side of the two, four or six-unit coil-box already there.

It will now be necessary to prepare the coils on the car which have been in use for ignition purposes. A permanent electrical connection must be made between the two platinum points on each vibrator. This may be done in either of two ways. The best method is to run a short piece of copper wire from the metal piece carrying the vibrator-spring to the metal piece on which the other platinum contact is carried. This allows the current that formerly flowed from one contact to the other, to pass through the copper wire, and the spring will no longer tremble when current flows. A quicker, although not as satisfactory a method, is to turn the adjusting screw on each coil until the two contacts are held tightly together, making the circuit complete at all times and preventing vibration of the spring.

The wires running from the coil originally used to the timer on the engine and to the spark plugs, are to remain, but all other wires to battery, magneto and switches are to be removed from the coil terminals. This completes the preparation of the coil formerly used.

If the car is equipped with two sets of batteries, or a set of batteries and a magneto (such as the Ford magneto),

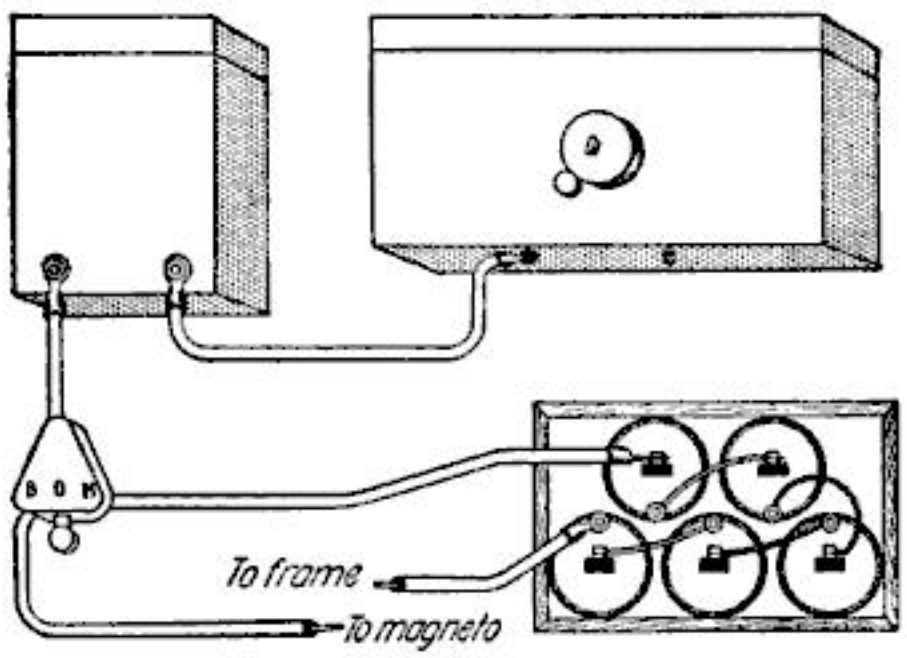


When the contacts are properly adjusted, the addition of this master vibrator greatly improves the ignition circuit

it will be necessary to fit a switch having three terminals, one for the batteries, one for the magneto or reserve set of batteries and the other for the coil connection. This switch will have

three positions, one being "off," one for battery and the other for the magneto or second set of batteries. If but one set of batteries was used, or if the magneto was used without batteries, it will be necessary only to use a switch having two terminals, one "on" and one "off." The switch selected should be fastened to the dash or to the box containing the master coil, previously described.

The system is then ready for wiring. A good grade of primary wire should be used, and the connections should be made with regular brass or copper wire terminals soldered on. The switch originally used on the coil case should be placed in one of the positions formerly used for running and allowed to remain there permanently.



Wiring diagram showing connections for master vibrator

If the position selected is on the "magneto" side, the following connection will be made to the terminal which formerly ran to the magneto; if on the "battery" side, to the connection which ran to the battery. This terminal, either battery or magneto, should now be connected to either terminal on the master coil.

If a switch having but two terminals was used, the remaining connection from the master coil should be connected to either switch terminal. If a switch having three terminals was used, this connection from the master coil will be made to the common terminal on the switch. This common terminal is the one that completes a circuit through either of the other switch terminals, depending on which way the switch is thrown.

If the switch having but two terminals is in use, connect the unused terminal to the battery or magneto through the wire which formerly ran to the coil on the car. If the three-terminal switch is used, run a wire from the terminal that completes a circuit when in the "battery" position to the battery, and run another wire from the terminal that completes the circuit when in the "magneto" position to the magneto. This can be accomplished by attaching the wires that formerly ran to the car-coil terminals to the new switch terminals.

Provided the connections have been made as directed and other wires have not been disturbed, the system is ready to operate when the master vibrator has been properly adjusted. This is done by turning the adjusting screw until the contacts are seen to separate. The screw is then turned in the opposite direction until the contacts just come together. Turn the starting crank or flywheel with the new switch in the "battery" position until the vibrator is heard to buzz; then turn the switch off without moving the flywheel out of this position. The vibrator may be adjusted by removing a spark plug wire about ¼" from the plug and again turning on the switch. Turn the adjusting screw one way or the other until a good strong spark is secured, replace the spark plug wire and start the engine as usual.

Cutting Brass

WITH a quill pin dipped in a strong solution of alcoholic corrosive sublimate, draw a line on the brass. Set it dry and then go over it with the pen dipped in nitric acid. The metal may then be broken like glass cut with a diamond.—JOHN SCHMELZEIS.

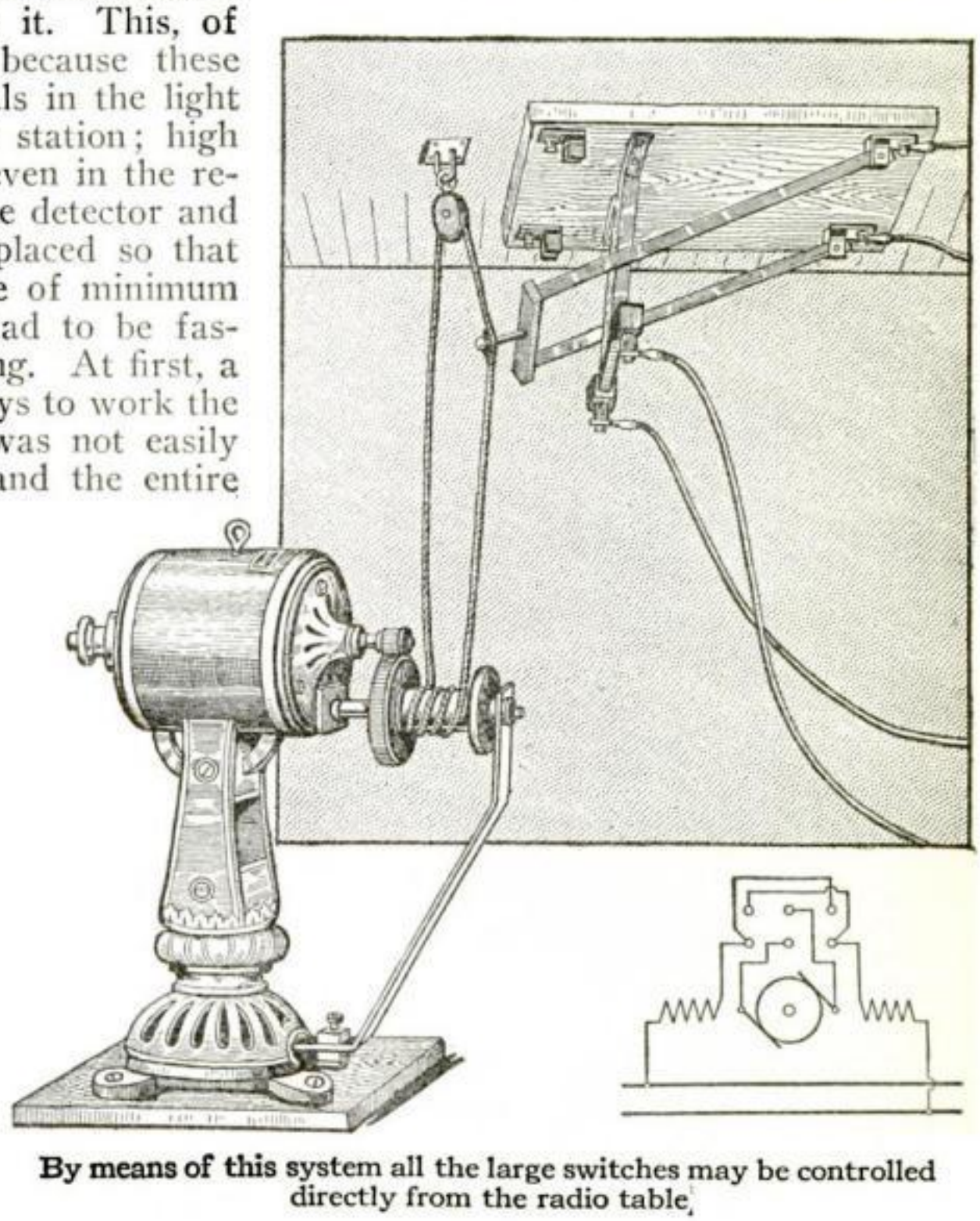
A Motor-Operated Aerial Switch

IN the DeForest sending equipment of a certain station, no anchor gaps are used, since the switching system for the aerial consists of a large D. P. D. T. switch with one side for sending and the other for receiving. The operators could not place the switch near the operating table, since then the aerial and ground leads for the sending set would have to run a long way to reach it. This, of course, is objectionable because these leads induce high potentials in the light and power wires in the station; high voltages may be induced even in the receiving set, burning out the detector and so on. The switch was placed so that the sending-set leads were of minimum lengths, even though it had to be fastened high up on the ceiling. At first, a system of ropes over pulleys to work the switch was used, but it was not easily operated from the table and the entire arrangement did not look good.

After having tried several ideas, one was found which is a working success, and the switch is now worked by a small, reversible series motor. A miniature electric hoist, with the motor, pulls a cord so as to throw the switch from one set of jaws to the other. The accompanying cut shows the systems installed. The winding apparatus consists of a drum driven from the motor shaft by a reduction gear. The drum is a wire spool having a 1½" core and 3½" heads and made 2½" long by sawing some of the core off. The cog wheels for the reduction gear were taken from a telephone magneto. The little cog was soldered on the motor shaft and the big one screwed on one end of the winding drum. The bearings and shafts of the magneto drive were also utilized. The shaft of the winding drum is supported on the motor frame by a bent piece of scrap iron and fastens on the motor base.

A series-wound motor, which drove a ten-inch fan, is used. It draws about one ampere from the 110-volt A. C. circuit. It is reversed with a small D. P. D. T. battery switch.

The cord is kept from slipping by tying a knot around a screw. The cord is then wound a couple of turns in each direction. One end goes to the switch handle, where it is tied fast, and then continues over a small awning pulley and back to the other end, where the two ends are tied together.



By means of this system all the large switches may be controlled directly from the radio table.

Besides the duty of reversing the motor, the control switch must disconnect the motor from service as soon as the aerial switch has been thrown. This was easily arranged by placing a bent spring of No. 16 or No. 18 brass between each pair of jaws of the control switch. Thus the switch handle kicks open and leaves the motor out of circuit, as soon as you release pressure, on either side.

Free and Forced Oscillations in Radio Telegraphy

By John Vincent

THE February article of this series pointed out how closely all oscillation circuits resembled each other, whether or not they contained spark-gaps and whether they were open antennas or closed condenser-circuits. Not all of the similarities were brought out, however, and it is interesting to note that for all practical purposes the rule last given, for finding the time period of an oscillating spark-circuit, is the same as that for determing the resonant wavelength of an antenna. The simplest way to work this out is to compute the period and wavelength of an aerial, such as shown in Fig. 1, according to each of the rules, and then to compare the results.

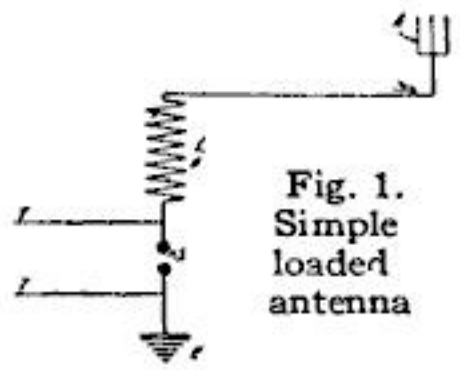


Fig. 1. Simple loaded antenna

Suppose the antenna system of this diagram has the constants given in the fourth example of the November article. The aerial itself will then be of 0.0012 microfarad capacity and 0.023 millihenry inductance, and the loading-coil will have 0.35 millihenry inductance. This last named figure is the sum of the inductances of secondary and loading-coil in the earlier example; the total is taken because in Fig. 1 only a single coil is shown.

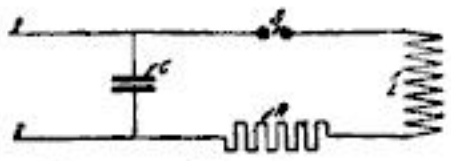


Fig. 2, Spark-gap circuit

Applying the rule for finding resonant wavelength, when capacity and inductance are known, the steps are: (1) multiply the total inductance by the total capacity (0.0012 microfarad times 0.373 millihenry = 0.000447), (2) take the square root of this number, which equals 0.0213, (3) multiply this result by 60,000 (0.0213 times 60,000 = 1,270 meters) and thus obtain the answer required. Thus the tuned wavelength of the antenna with loading-coil is found to be 1,270 meters. From the January article it appeared that this corresponded to the length of the ether-wave that would be set up when currents of a definite frequency surged back and forth in the antenna, and that the frequency could be found by dividing the wavelength in meters into the number 300,000,000 (which is the velocity of electromagnetic waves in meters per second). By performing this operation, it is found that the frequency of the 1,270-meter wave is 300,000,000 /1,270 =236,000 cycles per second. This is the resonant frequency of a circuit having the inductance and capacity above stated, or, in other words, the frequency of exciting alternating voltage which will produce the largest current in that circuit. At that frequency the current will be the greatest possible for any given voltage, because the circuit has minimum impedance when the capacity and inductance neutralize each other's reactive effects, as was also explained in January.

Now, taking the same antenna circuit of Fig. 1, and assuming the same values of inductance and capacity, the time period of natural oscillation may be found by applying the rule stated last month. This time period is the number of seconds which it takes for the alternating current in the circuit to pass through a complete cycle, i. e., to start from zero, reach a maximum in one direction, reverse, pass through zero and reach a maximum in the other direction, reverse again, and reach zero. The number of times this cycle is performed in one second is the frequency of the current, and is the numerical reciprocal of the time period. Since one millihenry is one-thousandth of a henry, the value of inductance may be given in either unit. Since for this antenna it is 0.373 millihenry, in henrys it is one-thousandth of

this, or 0.000373 henry. One microfarad is one-millionth of a farad; hence the capacity in farads is one-millionth of 0.0012 microfarad, or 0.0000000012 farad. Taking up the rule for computing the time period, the first step is to multiply the capacity in farads by the inductance in henrys (0.0000000012 times 0.000373 = 0.000000000000447). The second step is to take the square root of this number, which is found to be 0.000000669. The third step is to multiply this by 6.28, which gives 0.0000042 second as the time period. Thus it appears that the alternating current passes through a complete cycle in only 42 ten-millionths of one second, and that the frequency (which is the reciprocal of this) is a little over 236,000 cycles per second. This agrees with the result secured from the first calculation above.

If several other sets of capacity and inductance values are worked out by both the above rules, the same agreement will be found. It thus becomes clear that the resonant frequency at which any condenser-circuit will oscillate most strongly, is practically identical with the frequency of the free alternating current which will be produced if that circuit is set into vibration by a sudden discharge within itself. Referring to Fig. 1, if the capacity of the antenna is charged by a gradually rising voltage supplied from the secondary of a transformer through terminals T, T, a point will be reached beyond which no energy can be forced in, because the air between the spark-balls at S will break down. The spark which then occurs completes the oscillating circuit from the earth E through the inductance L to the antenna A, and the stored electrical energy rushes to the ground. By the overshooting action which always takes place, if the circuit resistance is not too great, the current surges back and forth. The frequency of the alternations thus produced is that which may be computed as in the paragraph above. This frequency is practically the same as that which would produce the greatest current in the antenna, if the transformer were disconnected and the spark-gap replaced by a high-frequency alternator in such a way that the total inductance and capacity remained the same.

An entirely similar condition exists for the closed circuit of Fig. 2. Here a condenser C, a spark-gap S, an inductance L and a resistance R are connected in series. The terminals of a high voltage transformer, to charge the condenser, are connected at T, T. If the potential applied across the condenser is gradually increased, a charge will be stored in it by virtue of its electrical capacity. When the voltage becomes so high that the spark-gap breaks down and a spark passes, the condenser discharges through the inductance and resistance. If the resistance is not too high, the discharge will be oscillatory, and the frequency of the oscillations (and their time-period) can be calculated according to the three steps of the same rule given for antennas. Thus the number of cycles per second of the free alternating-current discharge in the circuit can be found, if its inductance and capacity are known. The wavelength which would be set up by currents of this frequency may also be determined easily, as has been shown.

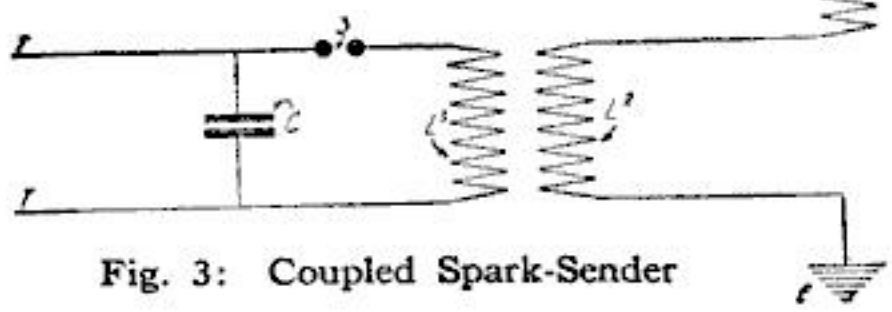


Fig. 3: Coupled Spark-Sender

If the transformer is disconnected and a high-frequency alternator substituted for the spark-gap, the circuit will have in it forced alternating currents of the frequency at which the alternator generates. As was shown in January, the greatest current will flow when the frequency of minimum impedance (or zero reactance) is reached. This is the resonant frequency and has practically the same numerical value as that of the free oscillations discussed in the paragraph immediately preceding.

The foregoing descriptions should give a clear indication of the difference between free and forced alternating currents in oscillation-circuits. If a sustained, alternating voltage is applied to

of any circuit, either from the outside (by magnetic induction, for instance) or internally by a high frequency alternator or other apparatus, a *forced alternating current* of the generating frequency will flow. The frequency of this forced current cannot be changed by varying the constants of the circuit, for it is determined by the generating source. The amount of current which is set up for a certain voltage, however, is governed very largely by the circuit constants. As was shown in

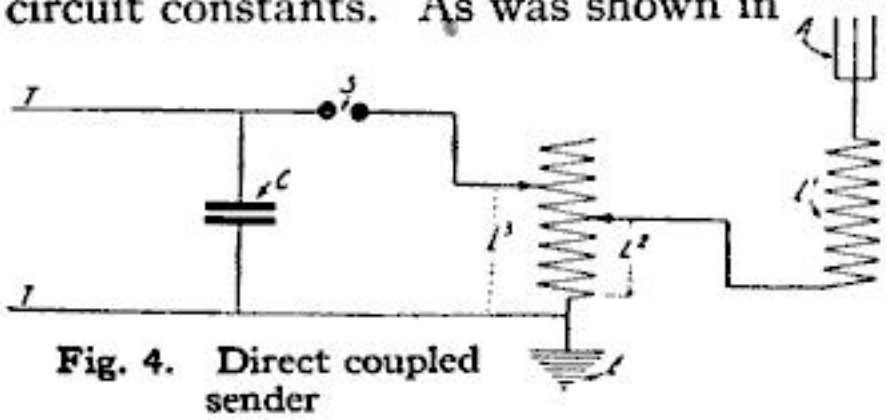


Fig. 4. Direct coupled sender

the January article, the greatest current flows when the applied alternating frequency is of the value for which the capacity and inductance of the driven circuit neutralize each other, or that for which the impedance (alternating current resistance) is therefore the smallest. The other type of alternating current, called "free," occurs when a condenser is charged and then allowed to discharge through an inductance and resistance (which must not be of too high value). The frequency of this *free alternating current* so produced is dependent entirely upon the constants of the circuit, and, for the same values of capacity and inductance, is practically identical with the resonant or minimum impedance frequency.

The critical value at which resistance becomes too high for free oscillations to exist in a condenser-and-inductance circuit, is almost never encountered in radio transmitters. It may be computed from a simple rule, as follows: (1) Divide the total circuit inductance, in henrys, by the total capacity in farads, (2) take the square root of this ratio, and (3) multiply the result by 2. The result is the "critical resistance" in ohms. For the antenna circuit of Fig. 1, this is found to be (1) 0.000373 henry divided by 0.0000000012 farad=310,000; (2) the square root of this is 556; (3) 2 times 556=1112 ohms. Thus if the resistance is less than 1112 ohms, the result of the condenser discharge will be oscillations at the rate of 236,000 per second; of course no ordinary sending circuit ever reaches so high a resistance value, so oscillations are always to be expected. In receivers, however, when detectors may be placed directly in series within the circuit, the direct-current resistance is often several thousand ohms. Free oscillations cannot exist in such circuits, but a definite tuning effect for forced oscillations is present, since, by adjusting the capacity and inductance reactances to neutralize, the greatest alternating current can be made to flow.

Referring to Fig. 2, it is obvious that for a given charge in the condenser, the greatest current will flow when the resistance R is of the smallest value. It is also true that the oscillations will persist for the longest time when this resistance is smallest. The actual resistance in circuit may be made only that of the wires and spark-gap, so that the free oscillations may be made to vibrate back and forth hundreds of times for each spark. In an antenna like Fig. 1, however, the effective resistance cannot be reduced indefinitely, because in addition to the spark-gap and wires forming the inductance and leads, the radiation of energy in electromagnetic waves adds a few more ohms. Because of this, and also because the capacity of an antenna cannot be increased indefinitely without great expense, the two circuits of Figs. 1 and 2, are often combined in the arrangement of Fig. 3. Here the coil in the closed circuit, L_3, forms the primary of a transformer whose secondary is coil L_2 in the open or antenna circuit.

When condenser C is charged and allowed to discharge through the closed circuit, free oscillations are produced of the frequency determined by the effective capacity and inductance of the circuit. In passing through the primary L_3, these free oscillations induce alternating voltages of their own frequency in the secondary coil L_2 and the connected antenna circuit $A\ L_1\ L_2\ E$. By adjusting the inductance of the secondary and loading-coils, so as to neutrallize the capacity reactance of the an-

tenna for the frequency of the closed circuit, forced alternating currents of the same frequency and largest amplitude will be induced in the antenna circuit. These large currents surging in the aerial will produce electromagnetic waves of the same frequency and corresponding length. Thus the discharge of a condenser in a closed circuit may be used to generate waves for radio telegraphy; for the best effect, the antenna circuit must be adjusted so that its natural frequency is the same as that of the closed circuit, or, in other words, both must be tuned to the wave frequency.

This principle may be applied to a case corresponding to the circuits of the average inductively-coupled amateur transmitter. Since the present laws limit amateurs to wavelengths below 200 meters, it is necessary to use such inductance and capacity in the primary as will give waves below this value. Practice has shown that it is not feasible to use a condenser larger than 0.01 microfarad in size; this, with an inductance $L3$ equal to 0.0011 millihenry (including lead wires), will produce free alternating currents of 1,500,000 per second frequency, which corresponds to 200 meters wavelength. Since, for this size of condenser, the total permissible inductance is so small, it will often be better to use smaller condensers and more inductance; for instance, 0.005 microfarad capacity and 0.0022 millihenry inductance or even 0.001 microfarad capacity and 0.011 millihenry inductance (both of which combinations tune to 200 meters) will give better results in many stations. The average small antenna, such as may be used for 200 meters sending, will have a capacity of about 0.0004 microfarad. The sum of inductances in coils $L1$ and $L2$ will therefore be 0.027 millihenry for 200 meters. The secondary may be made identical with the primary, and the balance of the inductance needed placed in the load coil $L1$.

The values quoted are not absolutely accurate, of course, for every station will have small variations in length of lead wires, closeness of coupling, regularity of gap action, etc., which may modify slightly the amounts required.

The best way to get true tuning-adjustment is to set the closed circuit at the desired wavelength, by calculation or wavemeter, and then to alter the coupling between $L3$ and $L2$ and the amount of inductance in $L1$, until a hot-wire ammeter in the antenna circuit shows the greatest possible current to be flowing. For good results, the coupling must not be too tight. When very small primary inductances are used in inductively coupled transmitters, it is not likely that the coupling will be tight enough.

The circuit of Fig. 4 is the equivalent of Fig. 3, except that the closed oscillation-circuit is directly coupled to the antenna circuit. Part of the primary coil is used as the secondary, as indicated by the portion between the right-hand clip and the earth, marked $L2$. The computations given above apply to this circuit as well as to that of Fig. 3, but, with the direct coupling here shown, it is sometimes possible to get satisfactory operation with larger primary condensers than when the inductive coupling is used. Since larger condensers make it possible to use more transmitting power for the same voltage and spark frequency, the direct coupling may be preferred in some senders. Contrary to the widely accepted idea, it is possible to get just as sharp waves with the direct as with the inductive coupling. It is necessary to tune the circuits with care, however, and to have the greater part of the total antenna inductance in the loading coil $L1$.

The above stated principles of tuning and adjusting various open and closed circuits for maximum effect, with both free and forced oscillations, include the fundamental laws of radio telegraphy and telephony. The simple rules which have been given in the five articles of this series may be applied to all types of transmitting and receiving circuits, and permit selection of apparatus which will operate successfully in various circumstances. The computation of receiving-circuit constants will be discussed next month; and after power in transmitters is treated, designs will be given for coils, condensers and other instruments which may be combined according to these rules.

Making a Simple Alternating Current Rectifier

A RECTIFIER is very convenient if audion storage batteries are to be charged and only alternating current is available. The ones on the market are rather expensive, but a simple apparatus can be made by anyone at small cost.

Thoroughly clean worn-out Sampson sal-ammoniac cells. Cut some sheet aluminum 1/32″ thick, the same size as the

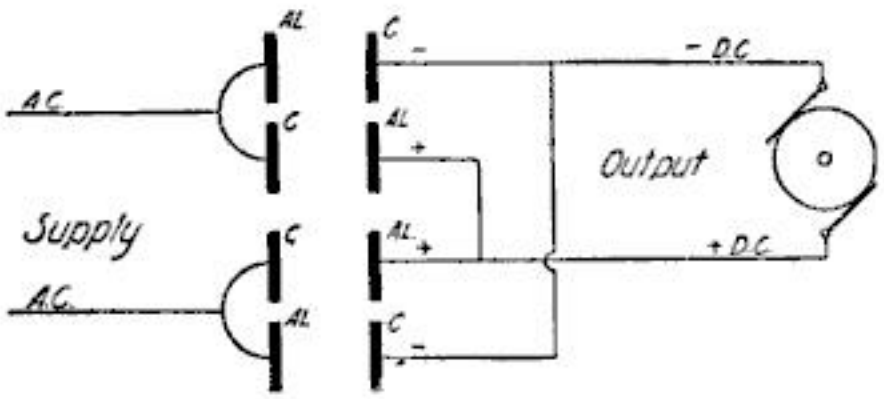
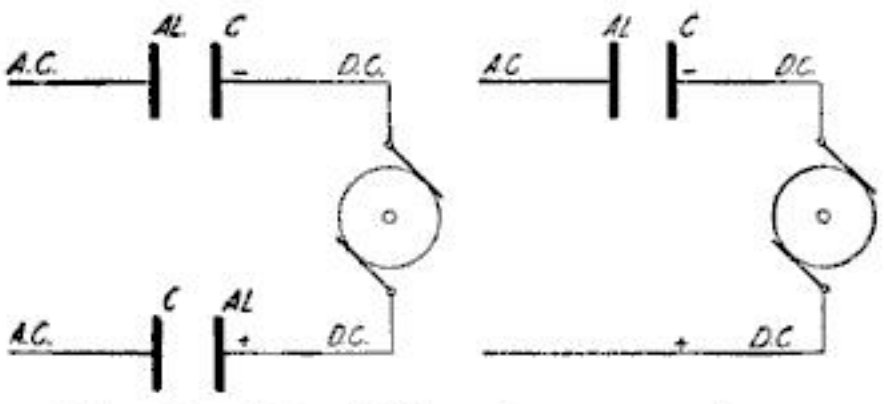


Fig. 1. How the jars are connected

zinc plates which belonged to the cells. These aluminum plates should be fitted into the old slots occupied by the zinc, and wires carried from them up through the holes in the jar covers, to serve as binding posts; or the old binding posts may be aluminum-soldered to the aluminum sheets. Insulate the aluminum by wrapping a few rubber bands around the carbon terminals.

Prepare an electrolyte by dissolving aluminum sulphate in cold tap water to the point of saturation. Fill the cells with this solution to the water level, indicated by a line about 1½″ from the top; the two poles are then completely immersed. Connect the jars as shown in Fig. 1.

The operation of the rectifier is based on the principle that for every half-wave a film of oxide is formed on the surface of the aluminum, preventing the flow of negative current. A rectifier of 1, 2 or 4



Figs. 2 and 3. Wiring for one and two-jar types of rectifiers

jars can be used, but neither the one nor the two-jar type will have 80 per cent efficiency. The one-jar type rectifies only one side of the wave. These types are shown in Figs. 2 and 3.

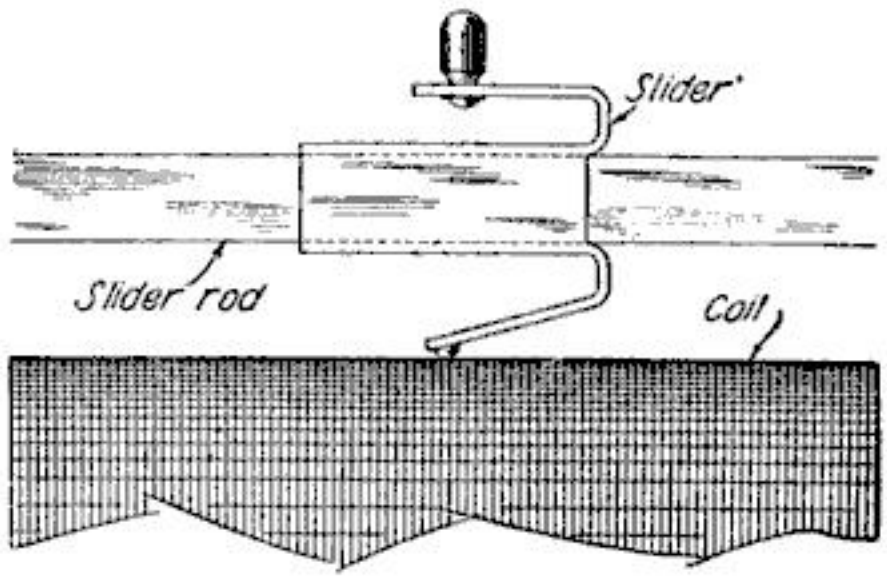
A Tuning-Coil Slider

THERE are many kinds of home-made tuning-coil sliders, but most of them have faults.

The most troublesome part is usually making the contact strip and fastening the handle. Since this requires almost constant use, it must be reliable and capable of working easily.

A good plan is to take a piece of square brass tubing, about 3″ long, and with a sharp hack-saw, slit down 1½″ on both sides. Then bend both parts, one up, the other down, and cut out the remaining piece inside, leaving two curved arms.

Now drill a 11/64″ hole at the end



A simple and efficient tuning-coil slider

of the upper arm, and with a sharp-pointed center-punch, make a small dent at the end of the lower arm, to form an excellent contact point, being much better than a drop of solder, since that is always liable to chip off. An 8-32 screw passes through the upper bent piece and serves as a fastening for the handle.

Radio's First Rescue

THE sinking of the S. S. *Republic*, which struck the *Florida* during a heavy fog, occurred in January, 1909. This was the first ship whose passengers and crew were saved by radio from what would have been almost certain death.

Reconstructing a Dry Battery

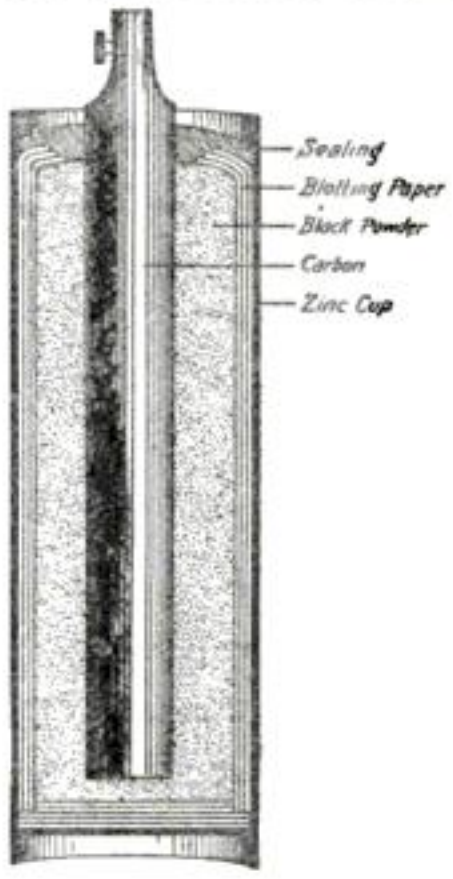
CONSTRUCTING or reconstructing a dry battery, if it is done carefully and with pure materials, will prevent the unfortunate experience of the amateur experimenter, who upon buying dry cells in an electrical store, finds they are old and that a generous portion of their strength has seeped out while lying on the shelves. So far as the cost of construction is concerned, a home-made dry battery is about as expensive as a standard ready-made cell. The only gain is in the life and consistent ability of the battery.

The foundation of the home-made dry cell consists of the zinc cylinder, carefully cleaned, from a worn-out battery. The cup should be boiled in clean water for several minutes. When the inner zinc surface is washed, it is lined with three or four layers of white blotting paper. This paper should be laid in firmly and held with clips but not glued. Two disks of blotting paper are placed in the bottom of the cup. Care should be taken that none of the inner surface of the zinc is exposed to the chemicals that are afterwards put in, or the life of the cell will be considerably shortened.

After blotting paper is in place, it should be soaked for several minutes in a solution of zinc chloride and sal ammoniac in distilled water. To arrive at the correct proportion of chemicals will take a little time unless a hydrometer is handy. The zinc chloride should be dissolved first. Crystals should be dissolved in the water until the hydrometer reading is 32 degrees. If a hydrometer is not available, a saturated solution of zinc chloride should be made; that is to say, a solution that has dissolved as much of the chemical as it is able. Add half again as much water as was originally used. This brings the solution to an approximate 32 degrees.

Powdered sal ammoniac should now be added until the solution is again saturated, when it is ready for soaking the blotter lining of the zinc. The soaking process should continue until the blotter can absorb no more of the solution.

Chemicals with which the battery is filled consist of a thorough mixture of two parts of manganese powder and three parts of powdered carbon or graphite. Carbon is cheaper. Coke is still cheaper, although it does not answer the purpose quite so effectively. Retort carbon, or arc carbon, pulverized in an iron retort, can be used. The two powders can be thoroughly mixed if they are placed in a covered jar of some sort, and the jar rolled and shaken carefully. Pains should be taken in mixing the powders, as a generous proportion of the battery's future performance depends upon this operation. When the manganese and carbon powders are thoroughly intermingled, they are moistened with the zinc chloride-sal ammoniac solution. Moistening the powder does not mean bringing it to a pasty state. It should have a damp, lumpy appearance.



Section through an ordinary dry cell

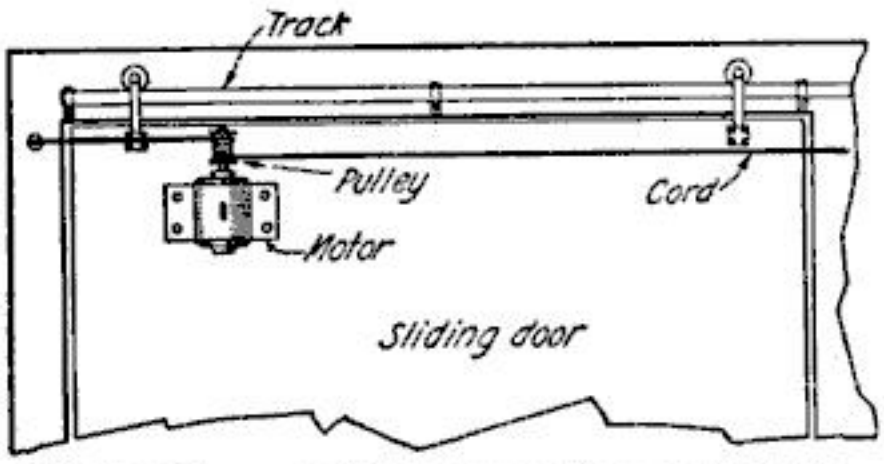
Tamping the mixture into the zinc shell is the next step, and it is the most important part of the process. After the carbon rod is placed in the center, the powder should be dropped in, a little at a time, and tamped down forcibly with a blunt stick and a hammer. It is a painstaking process, but the results are worth the effort. When the container is filled within about one-half inch from the top, the blotting paper layers are folded inward, and the rest of the space filled with sealing wax or a mixture of paraffin and resin.

Method of mixing materials in a mortar

When the battery is finished, if the directions are carefully followed, it should give excellent results.

Electric Door-Opener for a Garage

THE unpleasant climax to a motoring trip on a wet evening is the necessity of climbing out of the machine when the garage is reached, walking through the downpour and opening the door. This undesirable experience can be averted entirely if the garage door can be made to open by an electric motor, started by the closing of a contact in the roadbed,



Wiring diagram of door-operating mechanism

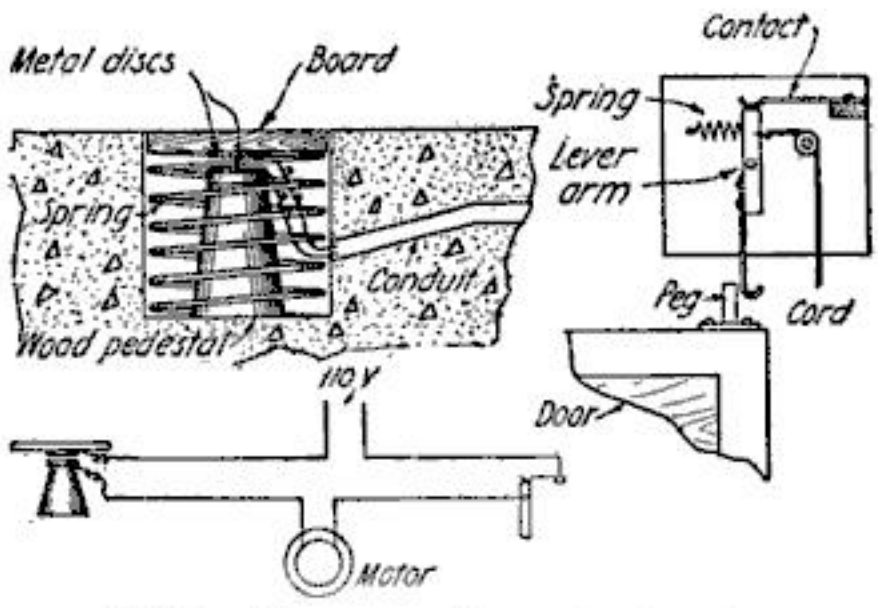
by the weight of one of the wheels.

A small pit should be cut in the concrete path at the entrance of the garage. The pit should measure 1′ across and 1′ in depth. A stout wood post should be erected from the floor of the pit and capped with a thick disk of copper or brass to which is attached a well-insulated wire. A well-seasoned board about 1″ thick, which will fit loosely in the mouth of the pit, should be cut and on the bottom of it screwed a heavy plate to which another wire is attached. The two wires should lead through a conduit, placed at an angle so that water will not leak into it, and terminating in the garage. The board should be supported, flush with the roadbed, by a heavy spiral spring. To drain the pit, a pipe of sufficient size should lead from one corner to a sewer connection. A white post, or a signal mark of some kind, should be put in the path close to the pit, for the purpose of marking its location when the automobile is driven upon the contact.

The door of the garage must be of the sliding type, and the rollers which run along the suspension track above should be oiled thoroughly, so that the friction is reduced to a minimum.

A motor, ¼ or ½ h.p., should be secured, by screws or lugs, to the door as near to the top as possible and very close to the edge which opens. The shaft, which should point upwards, should be fitted with a large friction pulley with wide flanges at both ends. A stout, non-stretching, braided rope should be attached to a screweye in the door jamb, at the same level from the floor as the pulley of the motor, three or four turns wrapped smoothly about the pulley, and fastened taut to a screweye in the opposite jamb. When the motor is operated, it is obvious that the rope will wind and unwind on the pulley, and the door will be pulled open.

A circuit breaker should be installed above the door at the back, so that when the door is wide open, the current will be shut off from the motor. Some pains must be taken in the construction of this circuit breaker, as it is a most important part of the apparatus. A short wooden peg projecting upward should be fastened to the top of the door. When the door slides open, this peg strikes a lever arm, and the circuit is broken. The lever arm should consist of a 4″ length of brass, ½″ wide and ¼″ thick. A small hole should be bored through its center to serve for pivoting purposes. At the lower end, a "trigger" of somewhat lighter and more springy metal should be soldered. When the peg strikes this trigger, the breaker will not be thrown out so suddenly as to derange the rest of the apparatus. The contact arm



Wiring diagrams of important parts

should be screwed to the center of some sort of wooden base upon a thick washer. The washer will act as a bearing. A light spiral spring, to insure a quick break, should be attached to the upper part of the arm and its other end held by a screweye set in the base. The contact spring should be cut from rather

heavy spring brass sheet. It should be bent, as shown in the drawing, and held securely at one end by a small wood block and screws. A stout, flexible cord should be fastened to the upper end of the lever arm and led out to a small pulley, from which it should hang within reaching distance of the floor. When the opening door causes the peg to strike the trigger and open the circuit, the circuit breaker should be re-set by pulling the string. Although not entirely advisable, the helical spring may be omitted, and a weight suspended from the lower end of the string so that when the door is closed, the breaker will be re-set automatically.

Connections of the various pieces of apparatus should be made as indicated in the accompanying diagram.

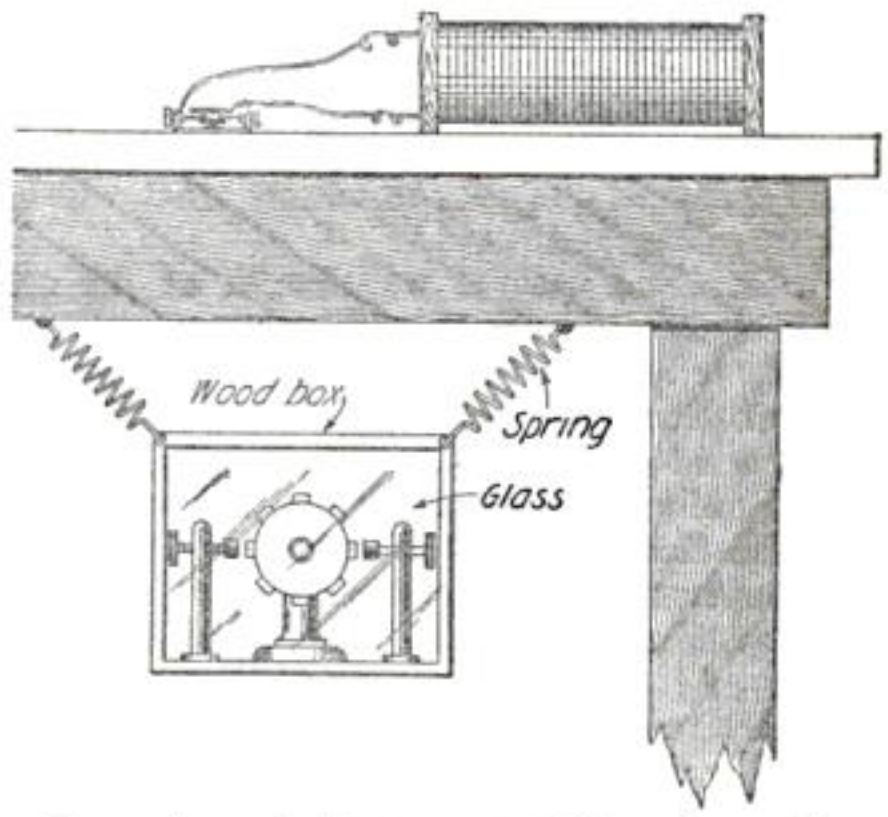
Briefly, the operation of the electric garage door-opener, is this: When the wheel of the automobile runs upon the board in the pit, the car should be stopped. The current from the line flows through the contacts and into the motor; the pulley revolves and draws itself, almost literally, along the rope, thus opening the door. When the door is opened, the peg strikes the trigger and the current flow is shut off.

There are various other ways of installing the motor and driving mechanism upon the garage door, but the one described is undoubtedly the cheapest. However, in case the clearance of the automobile roof is very small—too small to allow even for the small space that the rope occupies—the motor may be installed on the door jamb, and a bicycle cog mounted on the end of the shaft. A long bicycle chain should pass from this cog to another on the opposite jamb, and one of the door pulleys attached to the chain. Another method which would be simpler, perhaps, than either of the foregoing would necessitate only the installation of a magnetic release and a heavy weight operating through pulleys. If electricity were not convenient, a water motor could be used, or a water or compressed-air plunger, working on the principle of the plunger elevators, would give fairly satisfactory results. It is quite evident that much originality in construction is left to the builder.

Mounting Spark-Gaps to Eliminate Unnecessary Noise

A NOVEL and very good method of eliminating most of the noise made by a rotary spark-gap in operation, is shown quite clearly in the illustration. The rotary gap, with its motor, is mounted in a substantial wooden cabinet, with a glass door. This cabinet is then suspended on four strong spiral springs, from the underside of the operating table.

It is advisable to have the glass door on the cabinet closed tightly, so as to confine all possible noises and vibrations to the wireless room.



The springs eliminate most of the noise made by a rotary spark-gap in operation

Winding Tuning-Coils

A METHOD of winding tuning-coils so as to increase their durability and quality should be of interest to wireless amateurs. Most of those who wind their tuning coils and loose couplers with enameled wire find that it is hard to keep them from rubbing when the slider passes over the turn. This occurred with a coil which one correspondent has been using and which is wound with enameled wire on a hard rubber tube.

To prevent this loosening of the turns, one should, before winding the coil, wind an even layer of tire tape over the tube, and thereafter wind the wire over it tightly. This scheme will also prevent the wire from loosening much on a coil, wound on a wooden core, which may shrink. Soaking in paraffin also prevents shrinking of wooden tubes.

What Radio Readers Want to Know

Range of Station

S. D., Glendale, Cal., inquires:

Q. 1. With a four-wire aerial, 100 feet in length by 55 feet in height at one end and 70 feet at the other, connected with a "1500-meter" tuning coil, galena detector, 1000-ohm receivers, 43-plate variable condenser and a fixed condenser, how far should I be able to receive?

A. 1. The daylight receiving range of this apparatus is perhaps 250 miles, while the night range may be 1000 miles, depending largely upon the power of the transmitting station from which it is desired to receive.

Q. 2. With the foregoing aerial, ¼ K. W. transformer connected to the proper condenser and oscillation transformer, how far can I transmit and approximately what will be the wavelength emitted?

A. 2. The natural wavelength of the antenna system is about 300 meters, and radiated, it will be above that value by an amount depending on the number of turns and the general over-all dimensions of the secondary winding. If your station is located so that the Government Authorities will allow it to be operated at a wavelength of 300 meters, the daylight range will be approximately 50 miles. At a wavelength of 200 meters its probable range will be from 20 to 30 miles.

Condenser for Transmitter

LeR. D., Milwaukee, Wis., inquires:

Q. 1. How many plates of glass, 8 inches by 10 inches covered with tinfoil 6 inches by 8 inches, are required to make a suitable condenser or a ¾ K. W. Thordarson transformer?

A. 1. Assuming that this condenser is to be operated at a wavelength of 200 meters, its maximum capacity in any case cannot exceed 0.01 Mfds. With the dimensions given, the capacity of each plate is approximately 0.0006 Mfds. For a value of 0.01 Mfds. approximately 16 plates should be connected in parallel. If the potential of the transformer is 20,000 volts, the condenser should be split into two banks. You then require 32 plates connected in parallel in each bank and two such banks connected in series.

Q. 2. Please give the construction of a 0.5 Microfarad condenser.

A. 2. We infer that this condenser is to be somewhat similar in construction to the type used in telephone work and operated at low potentials. If so, two strips of foil, 6 inches in width by about 90 feet in length, are separated by a similar thin strip of paraffin paper. A second sheet of paraffin paper is then placed over one of the tinfoil strips and the entire unit wound up in circular form. The connections from each strip may be brought out to a binding post.

Q. 3. How many electrodes should be employed in connection with a rotary spark-gap having a disk 6 inches in diameter? The motor has a no-load speed of 6000 R. P. M. This gap is to be used with a ¾ K. W. transmitting set.

A. 3. With the transformer operated from a 60-cycle source of current supply, it is not advisable to produce more than 300 to 400 spark discharges a second. Assuming the load speed of the motor to be about 4000 R. P. M., it is recommended that the disk be fitted with 6 discharge electrodes equally spaced about the circumference. Excessive speeds are undesirable and unnecessary. The average commercial, non-synchronous, rotary spark discharger operates at a speed of 2400 R. P. M. and has 10 discharge electrodes mounted on the disk.

Q. 4. What are the names of the cities corresponding to the abbreviations sent out from Arlington in the weather forecasts, such as M, C, U?

A. 4. These abbreviations refer to important weather observation points. An interpretation follows: T, Nantucket; S, Sidney; A, Atlantic City; H, Hatteras; C, Charleston; K, Key West; P, Pensacola; B, Bermuda. For the Great Lakes the designations are as follows: DU, Duluth; M, Marquette; U, Saulte St. Marie; G, Green Bay; CH, Chicago; L, Alpina; D, Detroit; V, Cleveland; F, Buffalo.

Inductively Coupled Tuner

W. M. K., Windsor, Ontario, writes:

Q. 1. I have an inductively-coupled receiving tuner with a primary winding 4½ inches in diameter by 6 inches in length. It is covered for 5 inches with No. 18 enamel wire. The secondary is 6 inches in length by 3½ inches in diameter covered for 5 inches with No. 24 single cotton wire. Kindly advise the range of wavelength.

A. 1. The range of wavelength to which this apparatus is responsive depends upon the size of the variable condenser employed in shunt to the secondary winding, but with one of very small capacity it should be adjustable to about 2500 meters. The present winding does not represent the best design for an efficient tuner, since No. 24 wire is preferred for the primary winding and No. 30 or 32 for the secondary winding.

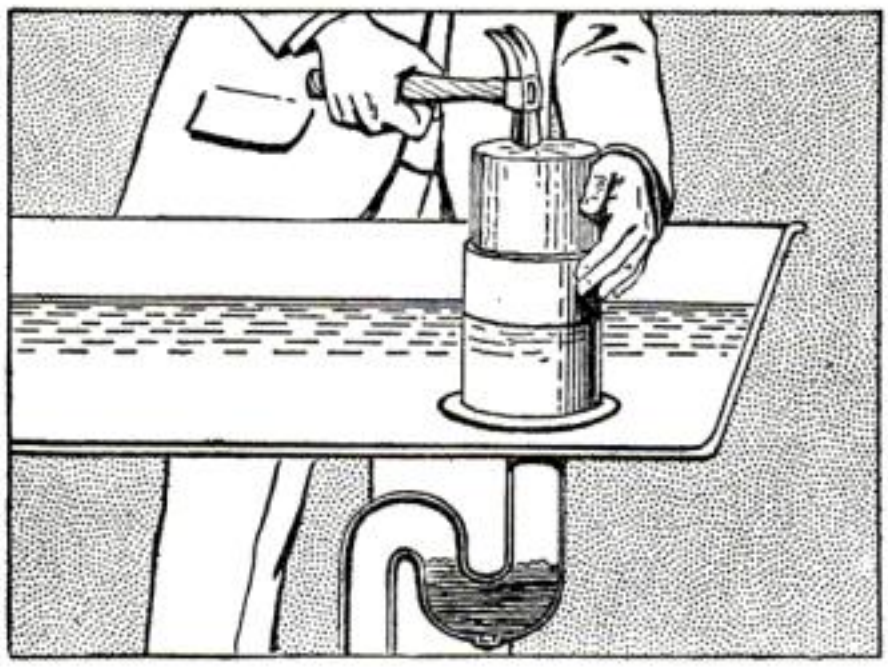
The Home Workbench

A Simple Method of Clearing a Clogged Waste Pipe

REMOVE the top and bottom from a discarded tomato or other can and place it over the outlet from the sink, as illustrated. Procure a block of wood that will easily fit into the tin, as shown.

With a hammer hit a sharp, strong blow on the wooden block, and away goes the stoppage. The tin cylinder prevents the force of the blow from spreading sideways and upwards. It is a fact that a stoppage seldom occurs in the trap, but usually at some bend or joint below it.

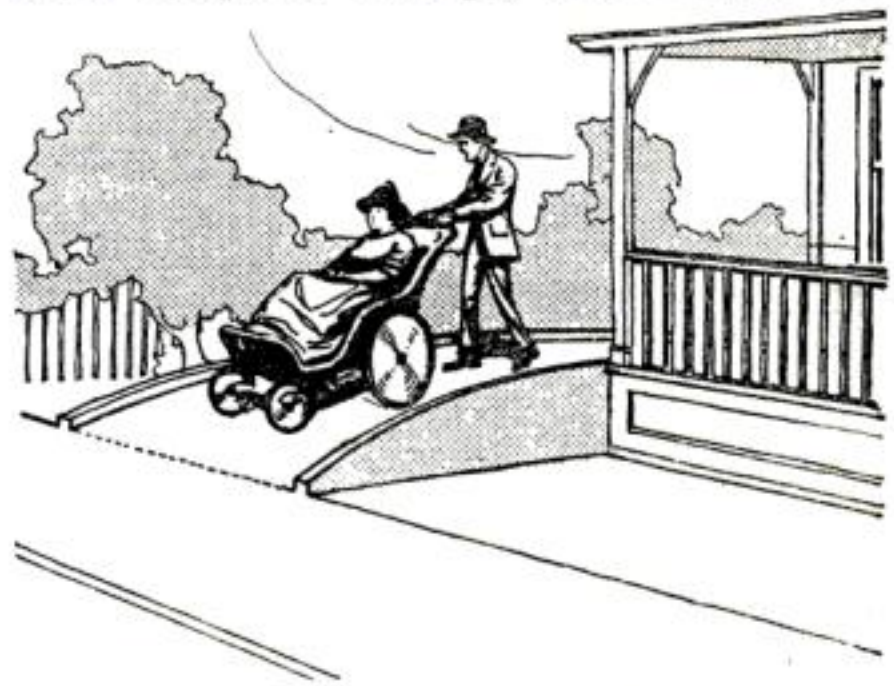
This scheme has been used before, but the addition of the can is a new idea, and is a big improvement over the old method of laying a board on top of the water and striking a blow, most of the energy being expended sideways. Of course the sink must be partly filled with water to use this idea, and the can must be held down firmly.



By striking the plug a sharp blow, the clogged waste pipe is cleared for the free passage of water

Inclined Sidewalk for a Wheeled Invalid Chair

IN homes where there is a wheel-chair invalid, the patient could have more frequent outings, were it not for



This inclined walk obviates the discomfort of jolting an invalid-chair up and down the usual stairs

the difficulty the nurse has in getting the chair down the steps from the house. Even where a strong person is able to get the chair and patient up and down the steps, the sufferer has to endure much uncomfortable jolting in the process.

This difficulty was solved in one home by removing the railing at one end of the veranda and building a new side walk, an inclined plane sloping down to the street walk, to take the place of the usual stairs.

While relatively few homes have invalids, the average home does have a succession of babies, and the slight cost of such a walk would be more than repaid by serving the convenience of the mother with the baby carriage, both in leaving and entering the home.

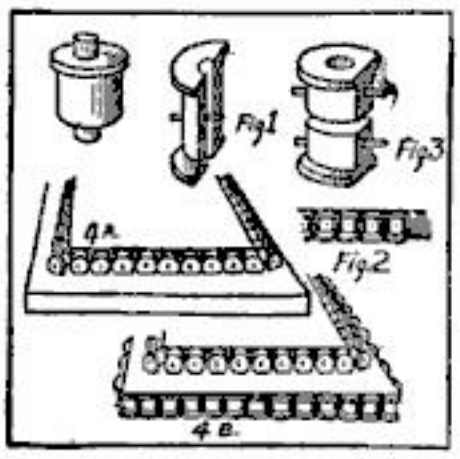
A Stand Made From Old Spools

A VERY pretty and useful music stand can be easily constructed with inexpensive material. Anyone who can use a hammer, saw, auger, varnish-brush and glue-pot, can make this stand at an astonishingly low cost. The material necessary can be obtained in almost any village. The use of the stand is not restricted to music, as the one the author constructed had various uses. The lowest shelf held a set of Shakespeare's works. The next was used for music books, the second for sheet music and the top for holding a lamp, a metronome and a match-holder.

The materials will mostly depend upon the advantages: Four boards (dressed to required thickness), 15″ x 24″; one board (dressed to required thickness), 9″ x 18″; four iron rods, 4′ x ¼″.

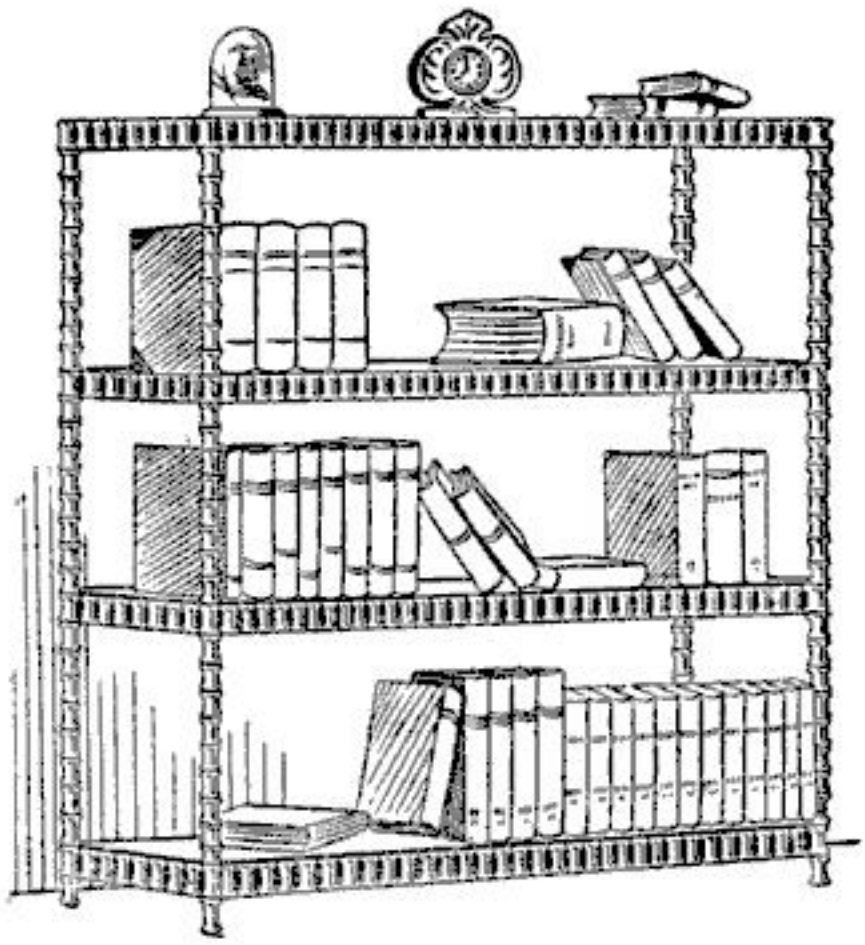
Tacks and putty are required, as well as spools of different sizes and shapes, nails, and glue. The boards will be dressed for a few cents at a planing mill; the rods can be obtained at a blacksmith's and the spools at a dressmaker's, tailor's or milliner's. Thumb tacks may be procured at a book store.

If possible, obtain spools that have had Nos. 36, 40 or 60 cotton thread, and dress the boards, of the first size, to a thickness equal to the length of the hole in the spool. This will vary with the size of the spool. Find points on the four similar boards, four inches from the corner, on the diagonal. This may be done by drawing the diagonals and marking on them points x inches from each corner. With a ¼″-bit, bore holes at these points in the four boards (x depends on the radius of the spool in Fig. 3).



Method of cutting and placing spools

Place the spools in a vise and saw each in two, making the cut parallel to the hole in the spool. Then drive the finishing nails, one in each half-spool, as shown in Fig. 1. Commencing at one corner, nail these half spools to each of



Music and book stand easily constructed at small expense and with few tools

the boards, the hole in the spool running at right angles to the top of the board. Some difficulty will be found in driving the nails into the spools, to avoid splitting the wood. The boards, when completed thus, will appear as in Fig. 2.

Take the board whose larger dimensions are 9″ x 18″ and complete it. It must be dressed. The spools required for it are common spools that have held silk thread. These must be sawn into halves, the cut made this time at right angles to the hole (Fig. 3). Next, with a good, sharp knife pare off the side, as shown in Fig. 3, just enough to prevent rolling. Then into some, drive nails, from one side to the pared side, as shown in Fig. 3. Dress the board to a thickness equal to the smallest diameter of the spool, and place this board centrally on one of the other boards. To do this, draw the diagonals on the under side of the smaller board, and measure one diagonal. Then from the middle of the other board (where its diagonals intersect) mark off on its diagonal lines equal to one-half the diagonal of the small board. The corner of the smaller board will coincide with the four points just marked. Lay the spools on the larger, around the smaller board, which has been nailed firmly to the larger board (nails being driven from underneath the larger board). The larger part of the spool is on the outside,

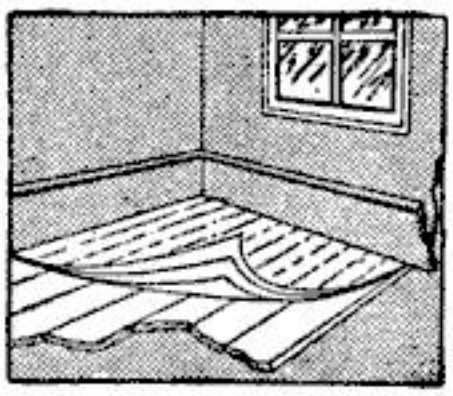
and the hole of the spool forms a right angle with the edge of the board next it. Having each spool touching the next, drive in the finishing nails. The spools will be arranged as in Fig. 4A and the board complete will appear as in 4B. In 4A the dotted lines represent the holes in the spools. The lower board has previously been covered with a light coat of glue, from the center to the line of the end of the spools.

Cut more spools like those used in Fig. 3, only do not drive in nails or pare. Then find the radius of the end of the spool (the smaller end). Suppose it to be x inches. Then mark off four points which are x inches from the four sides. That is, each point is somewhere on the diagonals, and perpendiculars from those points to the 2 nearest sides are x inches. Join these points together and then mark off, on the lines thus formed, points 2x inches apart. Count the points, and whittle that number of sticks which will fit snugly into the holes of the spools and are ⅜″ longer than the holes. With a gimlet drill holes at the points marked on the board, a little over ⅜″ deep. The gimlet should be exactly the same size as the pegs. Drive in each peg and before doing so, put some glue in each hole. Pour in enough to fll the hole. When the peg is driven in the glue will partly run out. Smear the upper part of the pegs with glue and put on the spools, with the saw-cut next the board. The glue on the peg and on the board will hold it. Push a thumb tack, which is also smeared (the point and underside only) with glue, into the top of the peg. These thumb tacks should be of brass, and are only for ornament. The corner spools, of course, are not put on, neither was there a peg driven in, the hole there being drilled with the auger. Varnish the four shelves, or stain to match furniture.

For the remainder, more spools are necessary. These spools must be in sets of 4, the spools in one set being all equal. The sets range from those containing spools of cotton basting variety to the small cotton thread, the sets getting smaller as they reach the top, though there should be a far greater number of small spools than large ones. One end of each rod is threaded and has a nut. Run these spools to the rods and varnish. When all is dry, assemble. Commence by putting the unthreaded ends of the rods through the upper shelf, extending above to half the depth of the spool. Glue the four spools, similar to those in Fig. 3, on the ends of the rods and board.

Then slip on the spools, in sets, smallest first, gluing the ends of the spools to make them stick. When 12½″ have been covered, put on the next shelf and 12½″ more spools and so on till the last shelf is on; then fill up with the largest spools and put on the nuts, cutting off any rod left over, though it depends on the size of the spools whether any will be over or not. Then set up the stand, and, filling in the holes of the four corner spools with putty, push in a thumb tack in each, and varnish the stand again. The author using this as a model, though varying a little in design, constructed a flower stand, though much smaller.

A Cheap Substitute for Linoleum



THREE sheets of strong, brown paper, pasted together, with a top covering of ordinary wall-paper, make an excellent, inexpensive, sanitary substitute for linoleum. After cleaning the floor, a sheet of good, strong, brown paper is pasted down and allowed to dry. Then a second sheet is laid and allowed to dry thoroughly before laying a third sheet.

If a pattern floor covering is desired, ordinary wall-paper serves the purpose admirably. It is pasted to the top sheet of brown paper already laid. The whole, being thoroughly dry, a coat of sizing is applied and left to set, after which a coat of good varnish completes the process. This floor covering has all the advantages of real linoleum and may be washed and polished in the usual way.

Lengthening the Life of a Worn-out Clock

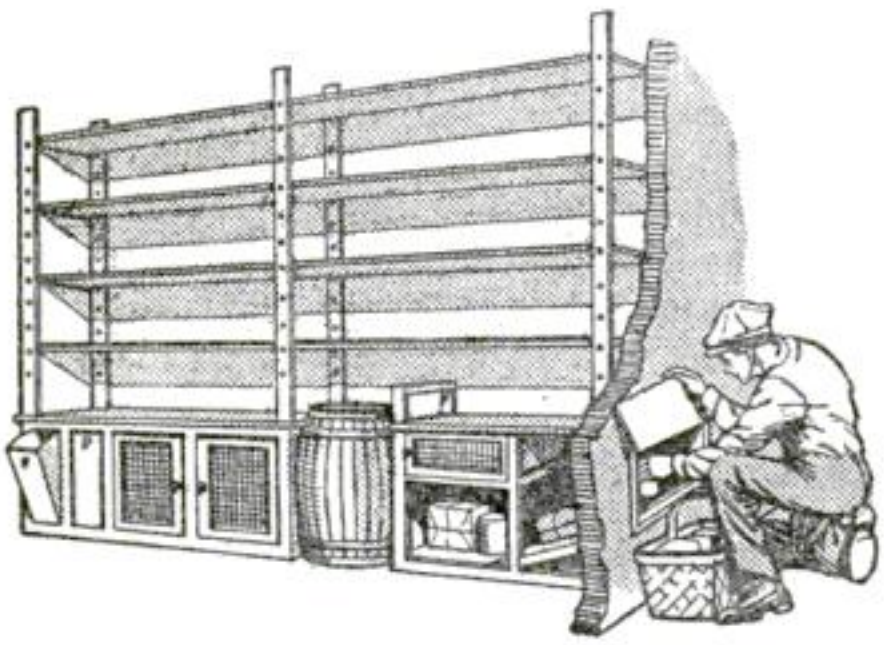
AN old clock can be rejuvinated and used for many years by increasing the distance of the escapement, or in other words, by prying apart the jaws just a mite.

An Extension to a Kitchen

By George E. Walsh

IN many houses, there is no room for little devices, especially when these are for the kitchen. The old house has been remodeled and extensions added, but the kitchen has not kept pace with the growth of the rest.

There is a great deal of work to do in too small a space. There are not shelves enough. What ordinarily can be stored on the first floor must be



This well-planned extension can be fitted to almost any house

carried down into the cellar.

This condition ends in a serious consideration of building an extension to the kitchen. A carpenter is probably consulted, and an estimate given, but nine chances out of ten this extension will be only an increase in floor area.

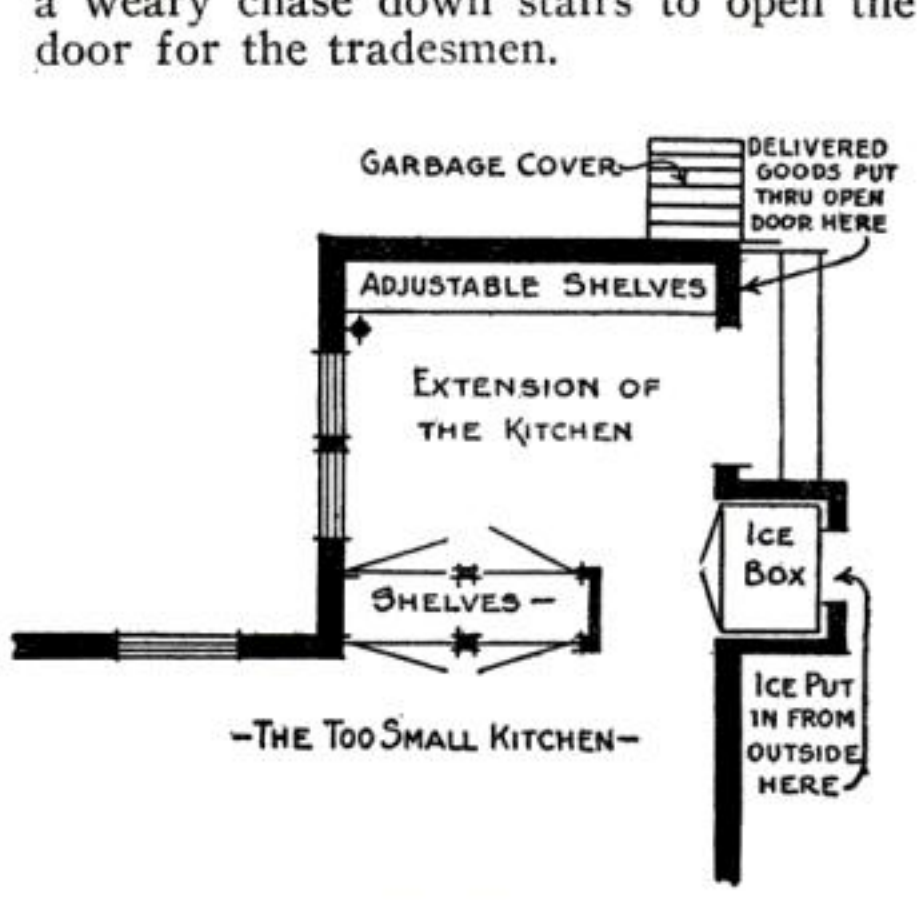
This would not be the case if the owner realized how many extra advantages he could obtain by making this change more thoughtfully. There are a great many devices which could be planned for. If foresight is used, many of the little conveniences can be built by the householder, after the carpenter has finished his job.

The first illustration shows a well-planned extension which can be fitted to almost any house. Arrangement has been made in it for various little contrivances. The storage of the food that is desired to be kept handy, such as crackers, cakes, bread and unopened groceries, can be put in the cupboard which opens both into the extension and into the kitchen. This saves many steps, because the supplies may be reached from either side. As all the doors are glass, quite a little light comes through into the kitchen from the extension.

At the further end of the extension, along the entire wall, are adjustable shelves for canned goods, preserves, vegetables, etc. These shelves are easily made, as shown in the diagram. They consist of six uprights with holes for pegs in them at intervals, upon which pegs the shelves rest.

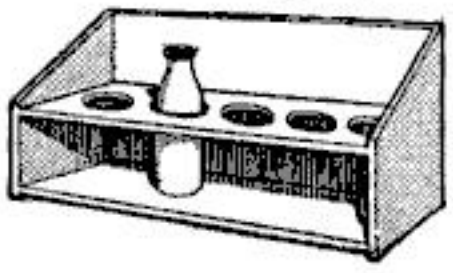
At the bottom, are lockers with screens and places for boxes and barrels of flour. In one end are deep drawers which work on hinges, and swing out and down, forming a trough in which loose sugar and flour can be kept. It is easy to scoop out the contents from them and save the extra labor of uncovering and covering barrels and tins.

A handy device for the delivery is installed at one side of the entrance. It consists of a small opening with a swinging door, something like a letter box. The goods, pushed through by the delivery boy, slide along an inclined plane out of reach. A small bell can be arranged at the side to give notice of delivered goods. This saves many a weary chase down stairs to open the door for the tradesmen.



Plan of the extension to the kitchen

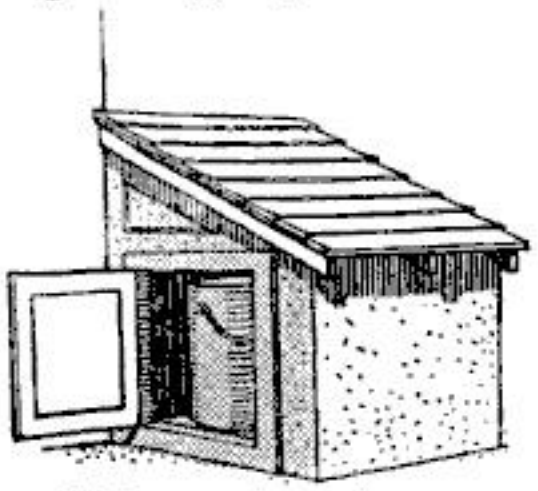
Ice is also put into the ice-box through a door from the outside. A small shed-like extension, just large enough for the ice-box, is built nearest the kitchen proper. The doors of the ice-box open on the inside, but a smaller one opens on the outside to permit the iceman to insert the ice from without.



This bottle rack prevents upset milk

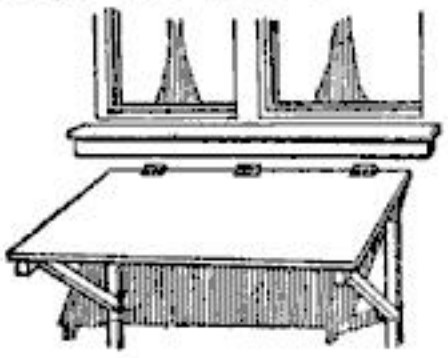
Because this ice-box extension stands out from the rest of the house, it is very cold in winter, so that no ice is then needed.

Another feature of the kitchen extension is the large window opposite the door. In hot weather this can be thrown wide open and netting put in. This makes a very cool place for ironing. A gas jet should be placed near for use with a gas iron, making the work even cooler.



This garbage-house keeps flies out and bad odors in

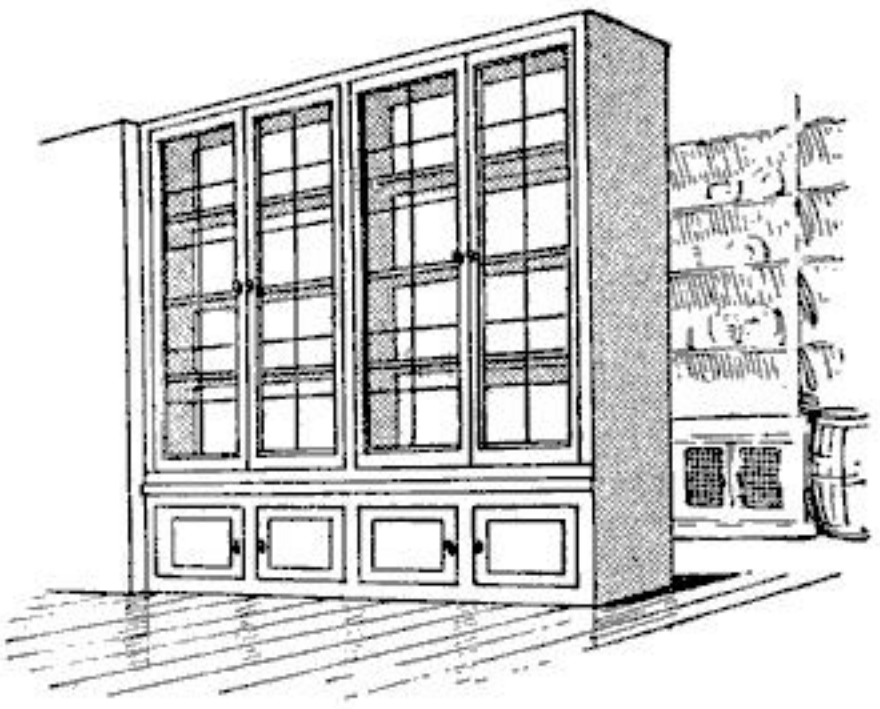
Around the corner of the entrance-stairs is built a cement garbage-holder. This consists of a small house with a roof over it, large enough to enclose the garbage pail. It can be slipped in or out by means of a door at the side. In the summer, this keeps the flies out and the odors in.



This collapsible table will be found most useful

Other small contrivances can be constructed in this extension. For instance, a rack with holes large enough to contain the milk bottles, can be fastened just outside of the door. This will do away with the nuisance of upset milk bottles.

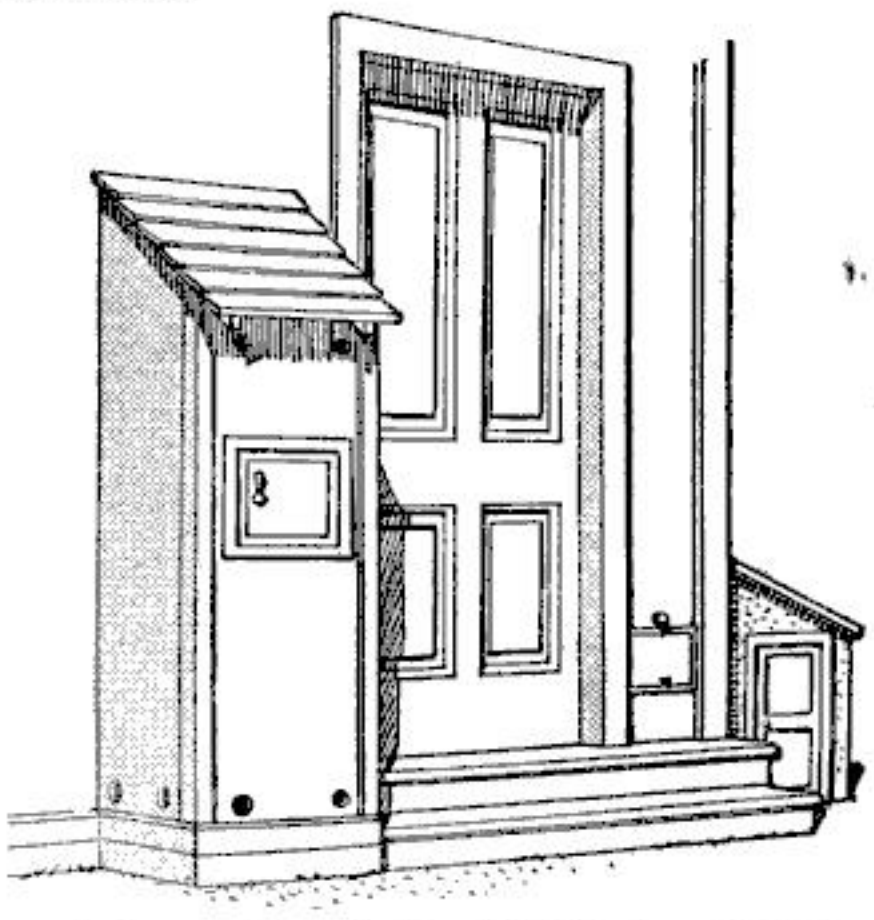
A collapsible table can be hinged under the window, or even a kneading board. A pair of heavy wooden brackets can be built near the ceiling out of reach of the head, for the purpose of holding a step ladder or clothes pole.



This cabinet will save the housewife many unnecessary steps

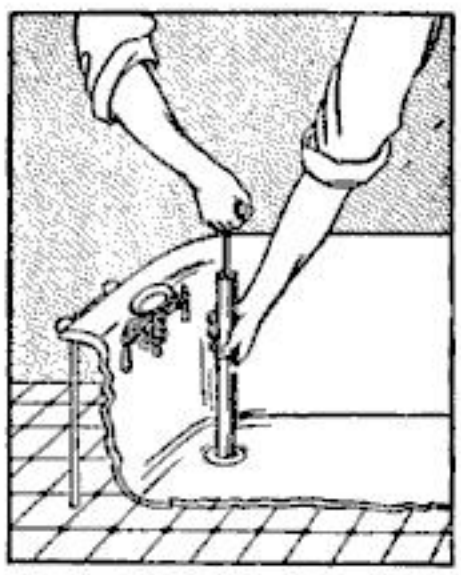
Indeed, many little devices can be built into an extension such as this, if arrangements are made for them in the beginning. They are all simple and can be home-built, after the main structure has been completed.

An extension with all these aids will be more than welcomed by the housekeeper. Even those houses which have kitchens of ample size would be helped by such an addition, for it divides up the work, leaving one part for cooking and washing dishes, and the other for storage, food preparation and laundry finishing.



A door on the outside of this ice-box allows the ice to be inserted from without

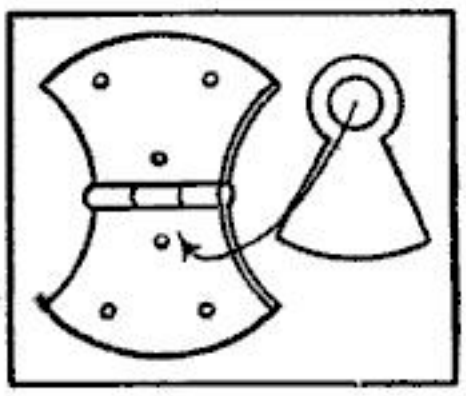
Using a Suction Pump to Clear a Clogged Drain



THE head-pump of an ordinary tin garden-sprayer may be used effectively for freeing a waste pipe from obstruction. Being unable to empty the bath tub, even by running wires down the drain, one experimenter prepared to bail it out, anticipating afterward a plumber's bill of $2 or $3. For bailing, he had, besides a basin, a tin suction pump detached from the reservoir usually included in the hand-sprayer.

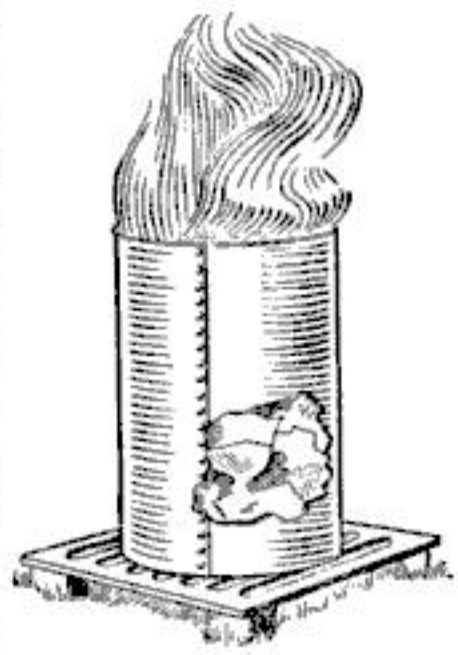
Taking up this pump, it occurred to him to try its effect over the vent of the tub. Pressing down the piston, he was astonished at the resistance, and on taking two or three strokes, found that the water was rapidly lowering in the tub. The suction pump, pressed down upon the drain, had given an opportunity for exciting its not inconsiderable force and, as a result, had dislodged the obstruction without further difficulty.—E. R. CHADBOURN.

A Door Retainer



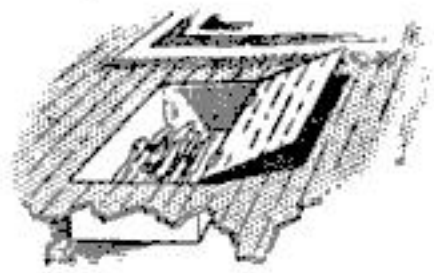
NOT wishing the horizontal top door of an ice-box or cabinet to fall clear back when opened, the device here shown may be used. From 1/16″ steel or brass, fashion a piece as in the illustration. The angle of the sides is equal to 180° minus the angle at which the door is to stand. The hole in the piece is equal to the diameter of the pin of the hinge on the door. Take the pin out of the hinge and file one of the pin-holders off, to allow the device just made to fit on the pin and in the inner portion of the hinge. Re-assemble the hinge and screw it on the door. When the door is opened this device will hold it up at the desired angle.—NOBLE LANDIS.

A Garbage and Paper Burner



A SATISFACTORY garbage and paper incinerator can be made from a cylinder of galvanized iron 14″ in diameter and 28″ in height. A cylinder of this sort can be made at the local tinsmith's for about seventy-five cents. In use, it is placed on an iron grate and the refuse ignited by placing it on a pile of dry paper in the bottom.—C. L. VESTAL.

Concealing the Spare Silver



IN building their home, a family provided a storage place for the "company" silver, which holds the entire supply when the family leaves home in the summer. In the clothes closet of an upstairs bedroom is a shirt-waist box on casters. This seems natural and attracts no attention. Beneath it is the hiding place in the floor. A section of flooring is hinged and below is a box for the silver.—AVIS G. VESTAL.

A Flower-Pot Hanger

WITH the coming of winter, it becomes necessary to bring in the flowers. The handy device shown can be made by any blacksmith. It consists of a frame for holding the flower-pot and a wall bracket for holding the frame. Both are made from ¼″ round iron, fashioned to the illustrated shape and welded together. The size of the iron hoop that encircles the pot is determined by the diameter of the pot just below the top flange. The size of the bracket is determined by the weight of the pot and its size. Good judgment only is needed to make either of these parts.—NOBLE LANDIS.

A Modern Sanitary Hog House

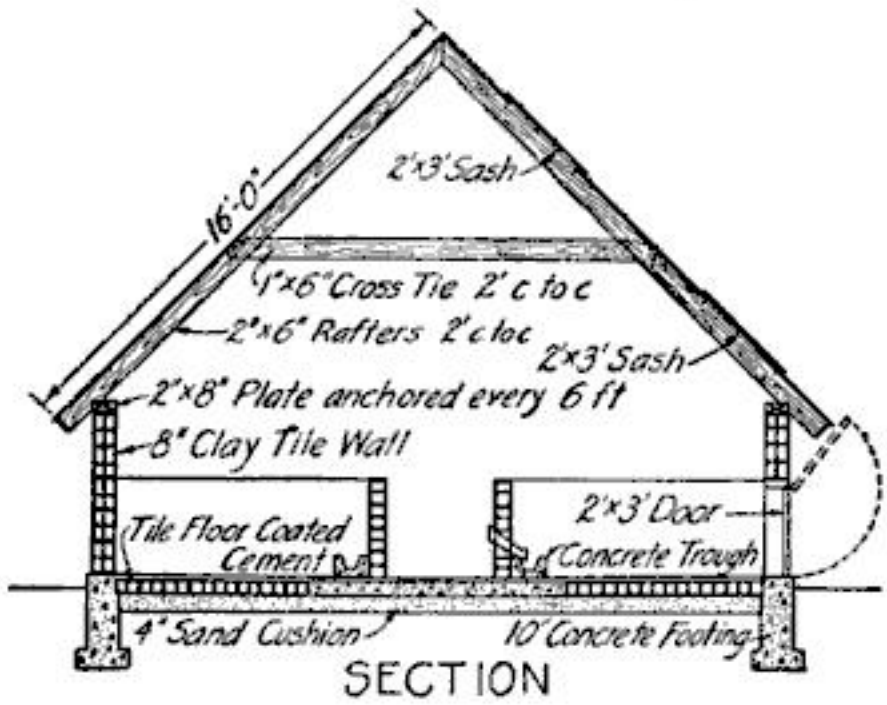
IN Iowa, where the hog is given the first place on many a farm, hundreds of new hog houses have been built. They are very practical, easy to build, and make the most of the materials. Houses built after this plan harness the sunlight most effectively. The windows are in the roof, that is on the south slope of the roof, which is at half pitch. Any farmer who has only ordinary skill can put together such a structure during the nothing-to-do period on the farm or at the end of the rush season.

The foundations for the walls are made of concrete and go down below the frost line, so that the tile-walls will not crack. The pen-floors are of hollow clay, tile laid, on a sand cushion. This makes a warm and dry bed for the old mother sow and her litter. The pen partitions and the walls of the house are made of clay tile 8″ thick, and a stanchion is bolted to the wall every 6′. The rafters are 2″x6″ and are 16′ long and spaced 2′ apart.

The house is solidly put together, if the plan here shown is followed out by the builder. It will need but little repairing. The materials that will be needed for the farmer who will want to build such a house have been listed below. For a sixteen pen house, that is with eight pens on both sides of the center feed-alley, and with pens 6′x8′ in size, the materials will cost at the rate of about $20 per pen in many sections. For a house that has outside ground dimensions 21′ x 50′ the following materials will be needed:

25 barrels cement for foundation and feed-alley floor.
2,500 hollow, clay blocks for floor and walls, 5″x8″x12″.
10 pcs. 2′x8′—10′ for plates.
52 pcs. 2′x6′—16′ rafters for roof.
26 pcs. 1′x6′—12′ cross ties for rafters.
1,600′ roof-sheathing.
15,000 cedar shingles for roof.
16 skylight sashes for roof.
16 pen doors, 2′x3′.
2 doors, 3′x7′.
1 metal cupola, 18″.

Stake out the building site, 21′x50′, and inside the lines dig the foundation trenches. These are 10″ wide and 2½′ deep. If the ground is solid, wood forms will not be needed, but always use care and do not jar loose any of the trench walls when pouring concrete into them. Make the concrete with one sack of cement, three cubic feet of sand and five of gravel. Mix



Floor and section plan of sanitary hog house

the sand and cement thoroughly before adding the gravel and the water. Slush the mixture into the trench at once and be sure that the top is leveled off properly.

The tile walls (8″ thick) of the house are laid directly upon the concrete foundation, as the diagram illustrates. The common size blocks are 5″ x 8″ x 12″ in size. Lay them flatwise in the wall. Use a lime and cement mortar, but only a small amount of lime will be allowed, not to exceed one tenth part by volume. The lime makes the mortar plastic, so that the mortar will stick to the ends of the blocks when they are being laid up in the walls of the hog house. The tile walls of the

house are 5′ in height. When the last course of tile is being laid, do not forget to insert the anchor bolts in the mortar joints every 6′. Let the threaded end of the bolt project at least 2½″ so that the 2″ x 8″ wood plate can be securely bolted to the tile wall. It is then possible to spike the roof rafters of the house to this wood plate. As the tile walls are going up, set in place the door frames for the pen doors and also the end doors. These are only made of 2″ x 8″ planks, with spikes driven into them so that they will be well bonded to the tile walls.

The roof building is the next step. Make it at half pitch with the 2″x6″ rafters, 2′ center to center. Use 16′ lumber and tie every set of rafters with a 6″ board 12′ long. This makes a stiff frame and a solid foundation for the roof. Any cheap lumber can be used for sheathing. Space the boards 1½″ apart. The cedar shingles should be applied with galvanized three-penny nails and laid with not over 4½″ exposed to the weather. The roof sash or the skylights have a metal flashing so that they will not leak. These sash frames are set in place as the roof is being shingled. The roofing will run up over the metal flashing. The glass in the roof sash is covered with hardware cloth to prevent hail damage. That completes the shell of the house.

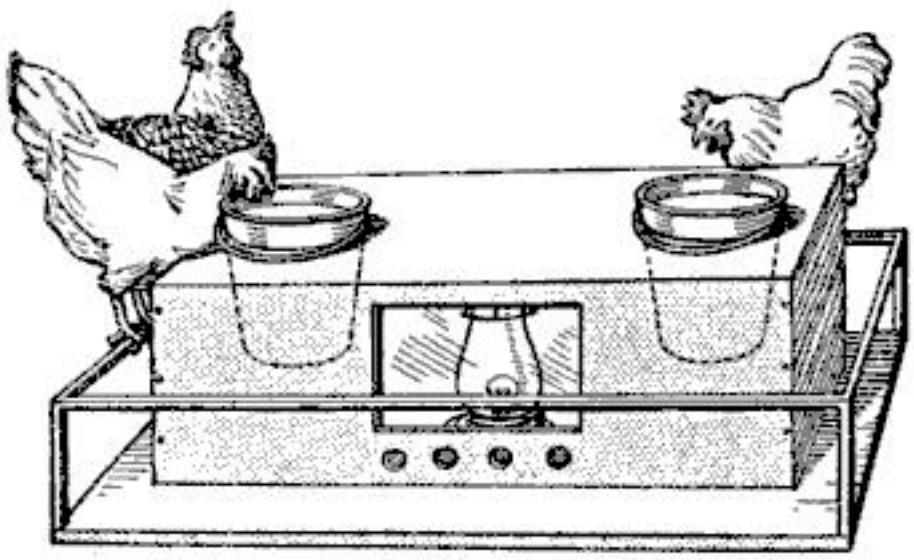
The floors are the next step in the process of erecting a modern hog house. The tile for the floors may be seconds. Lay them on a well-tamped sand and gravel cushion and cover the tile and the joints with a rich mixture of sand and cement, mixed one to two. A floor so made, with an air space under it, is warm, dry and healthy. The feed-alley floor is all concrete, 5′ thick, and the hog-troughs are made of the same material. The pen partitions can be made of either tile or wood planks. Make the pens size 6′ x 8′. This is the generally accepted standard-size farrowing pen.

The recent cholera epidemics and other swine troubles have in a large measure been traced back to the old filthy, germ-ridden, dark hog pens on most corn-belt farms. This great loss from disease has taken millions of dollars from hog growers' bank accounts. It has driven home a lesson, nevertheless. It has, in a way, revolutionized the management of swine and has brought about a general cleaning-up policy, better sanitation and better health for the porker, so that he will be in a prime condition to fight disease when it appears.

A Hen-House Water Supply Which Will Not Freeze

TO make a non-freezable drinking fountain for the hen house the following material will be needed: One soap or cracker box; a lantern; two galvanized iron pails, about two-quart capacity; and enough heavy asbestos paper to line box with a double thickness to keep in the heat generated by the lantern and for fire prevention.

The box must be large enough to hold



The deflected heat from the lantern keeps the fountain from freezing

the lantern and two pails. Two holes are cut in the top of box, one at each end, allowing the pails to sink into the box with only about 3″ protruding; inside the box, between the pails, the lantern should be placed. The heat will be deflected by the lantern top and the box around the water pails, thus keeping the water a few degrees above freezing even in coldest weather.

The box is placed on a platform. This, in addition to being a support for perches on which the fowls stand while drinking, is also the bottom of the heat box upon which the lantern rests. When filling or cleaning the lantern, the box and pails are lifted from the platform, but when filling the pails, they are simply removed from the holes.

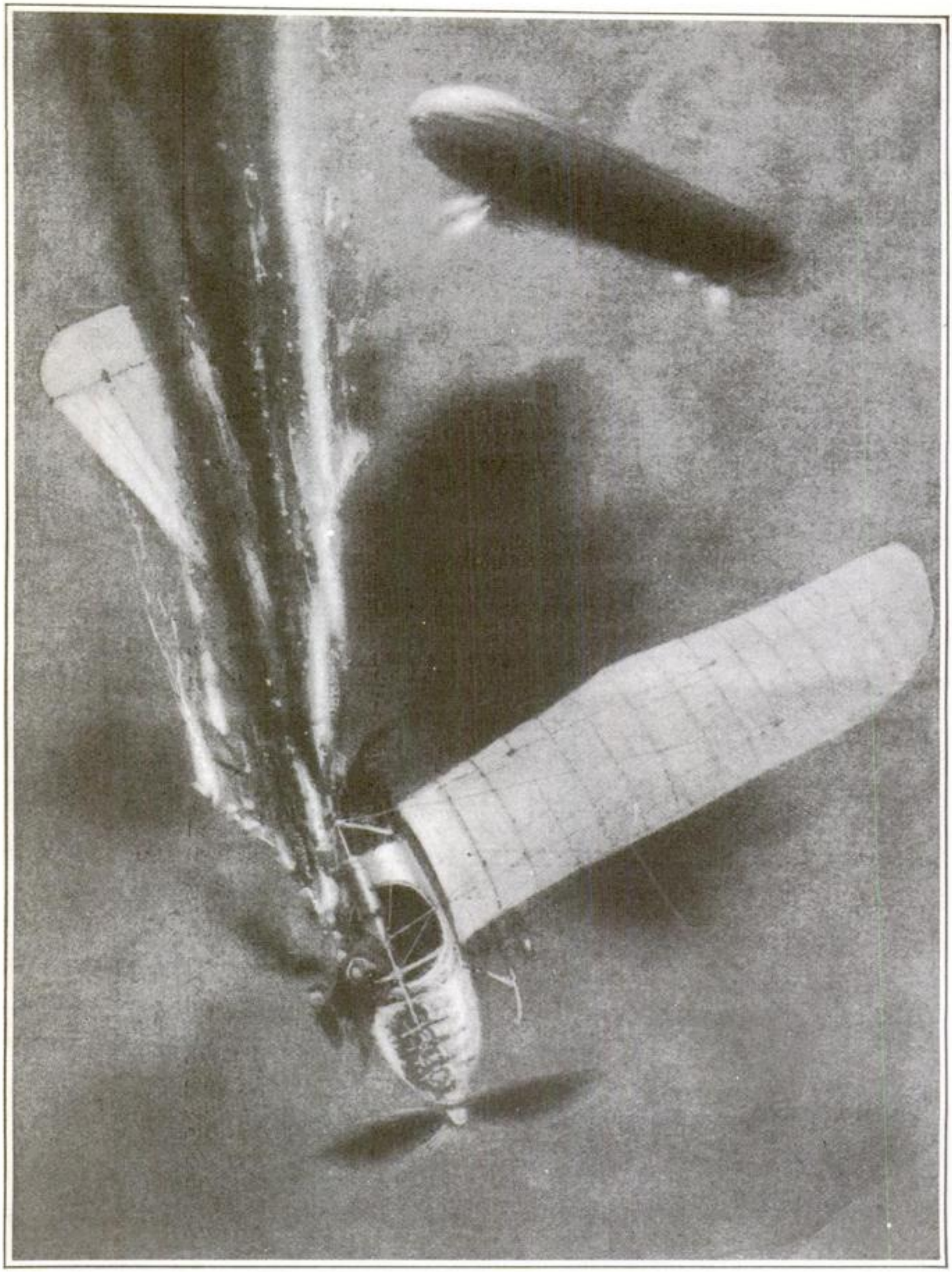
Money Prizes for Radio Articles

We want you to tell our readers how you have overcome your wireless troubles. Every radio operator, commercial or experimental, has encountered difficulties in building or using his apparatus. Many different people are bothered by the very same problems day after day, and it will help you to learn how others worked to get successful results. It will help others to learn how you succeeded.

For the two best articles describing how you overcame troubles in building, operating, adjusting or repairing any radio instrument or group of instruments, we offer first and second prizes of **$25.00** *and* **$15.00** *respectively. The Judges of the Contest, who will be the Editors of the* POPULAR SCIENCE MONTHLY, *will select the prize-winning manuscripts from those which conform with the following conditions. The prizes will be awarded to the two writers whose articles, in the opinion of the Editors, will prove most helpful to the readers of the magazine.*

Conditions of Prize Contest

1. *Manuscripts must be typewritten, on one side of the paper only.*
2. *Illustrations must be on sheets separate from the manuscripts.*
3. *Articles must be addressed to the Radio Prize Contest,* POPULAR SCIENCE MONTHLY, *239 Fourth Avenue, New York, and must reach that address before June* 15, 1916, *in order to be considered.*
4. *Manuscripts which do not win prizes may be purchased for publication, at the option of the Editors and at the usual rates.*
5. *The decision of the Judges, which will be announced in the August,* 1916, *issue, is to be final.*
6. *Each manuscript must be accompanied by a letter containing criticisms and suggestions as to the wireless section of the* POPULAR SCIENCE MONTHLY. *The merit of these letters will not be considered in awarding the prizes, but their suggestions will be taken as indications of what types of articles are of the most value to our readers.*
7. *If contestants wish to have their manuscripts returned, they should send postage for that purpose.*
8. *Articles should not exceed* 2,000 *words in length. If you cannot compose your information in that length, write more than one article on different phases of the subject, each article to be independent.*



The End of a Battle in the Air

A few years ago military experts considered fighting in the air an improbability and declared that the aeroplane and the Zeppelin would be useful only for scouting and bomb dropping. Now, battles between aeroplanes are so common that they are seldom mentioned in the dispatches. Aeroplanes as yet have been able to accomplish little against raiding Zeppelins. The anti-aircraft guns are the Zeppelin's greatest enemies, and these Paris and London dare not use lest the projectiles fall back in the streets